Installation and Arrangement of High-Tension Equipment—together with engineering and technical contributions of timely interest

Electrical World

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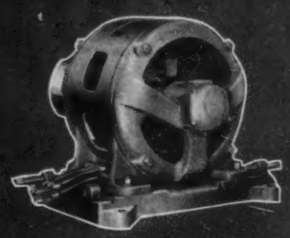

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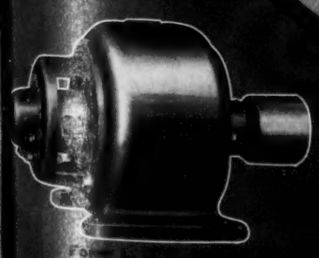

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Honor to Whom Honor Is Due

IT is fitting that Elihu Thomson should be numbered among the recipients of the Fritz and Hughes medals. We are proud that he has been thus honored. The awards come to him in the prime of life to buttress and to accentuate the consciousness of work well done. While they are bestowed in recognition of his achievements in electrical inventions and scientific research, they are none the less a tribute to the profession of electrical engineering and reflect credit on the United States, for both the medals are international awards. That a busy, war-beset world can pause to render homage to one who has so markedly and so profusely contributed to its comfort and uplift is significant. His inventions have been many and varied; his contributions to engineering literature are classics; work for him has been a pleasure and a profit, for success has crowned his endeavors, and the glory of achievement has been enhanced by the continued fellowship of professional men whose praise has been as unselfish as his devotion. But no enumeration can suffice to measure him as a man. Awards are but empty honors if they do not carry with them the respect, love and honor of his fellows as well. All these he possesses or else the exercises at Boston last week were a sham.

Justifying Auxiliary Plant Capacity

TO the operating engineer and plant manager the justification of specific reserve capacity in an installation may appear like an unnecessary task, but the importance of being able to show how each boiler battery and prime mover, each generator and important auxiliary "earns its keep," is sometimes very material to the success of the plant owner's case. In a recent street-lighting hearing the question arose relative to the value of holding six 1500-kw. engine-driven alternators in reserve adjoining a modern turbo-generator plant several times as large. The engineer called to the stand on behalf of the operating company had no difficulty in meeting the inquiry by introducing operating records showing the exact dates on which the engine plant was run, the cause of the shutdown of equipment in the turbine installation, and the number of kilowatt-hours of energy delivered from the engine station in the period of emergency service. Incidentally the engineer-witness remarked that although it is intended soon to install a 30,000-kw. unit in the turbine station, the engine-driven sets will be retained for a considerable period in the future, while the various smaller turbine sets (as compared with the later units) will be held at the plant for a long time indeed, in order to enable the load requirements to be economically and reliably handled. The point was made that the company would never consider itself safe, even for a single night's run, unless it had reserve capacity floating on the line equal in rating to the capacity of the largest unit in service at any particular moment. Facts like these go a long way toward justifying investment in auxiliary equipment and consequently the right to earn a reasonable return upon the money so involved.

Consolidation of Southern California Systems

THE merging of the two great transmission companies of southern California which was announced in our news columns last week means much both in an engineering and an economic sense. Duplication of system where both companies competed for business will no longer obtain; excess of reserve steam and water-power equipment will be avoided and material savings will be effected in the executive and operating organizations. This is as it should be. Any movement which ultimately leads to the more economical generation and distribution of electricity is commendable. It involves real engineering in its broadest sense. We hope that ultimately the other systems operating in the same and contiguous territory might also be embraced in some operating plan at least whereby the various stations will be looked upon as part of a single system and the maximum possible economies realized. All of the generating companies centered at Los Angeles for instance possess huge and efficient oil-burning steam stations. With the completion of the Big Creek hydroelectric stations of the Pacific Light & Power Corporation, the latter discovered that its magnificent Redondo steam station would not have to be used as much as before to make up deficiencies in energy required for the system, and would hereafter be simply a reserve plant. With the tying together of the hydroelectric and transmission systems of the Southern California Edison Company and the Pacific Light & Power Corporation the former will undoubtedly find that its largest station, the steam turbine station at Long Beach, will likewise fall into disuse and become a reserve station, and with oil at present prices a fortune is saved at once by transferring a load ordinarily carried by steam onto water-power equipment. Moreover the service of the combined companies becomes more reliable. Absolute shutdown is guarded against by suitably inter-connecting the systems so as to permit transfer of load from one hydroelectric station to another. If the worst comes to pass, the huge steam stations outside Los Angeles can be brought into service on short notice. By simply interconnecting large contiguous systems into a group and operating them as one, the possibilities of savings are

so great that it is singular that more of it is not done. Single ownership is not necessary and is not necessarily implied in single operation, although single ownership might naturally follow. What is necessary is for owners and managers to be far-sighted enough and broad-minded enough to pool their generating systems so as to make further economies possible. Other industries have learned how to turn their by-products into cash and it is unwise of managers of huge systems not to make the maximum use of all their generating facilities when by the simple process of co-operation an excess on one system can be used to supply a deficit on another.

Secret Wireless Receiving

THE idea of using small concealed aerials, whether of the ordinary open or the closed magnetic loop types, with extremely sensitive modern radio receiving instruments, seems to have occurred to a number of experimenters. In the laboratories of the Bureau of Standards, United States Department of Commerce, such combinations have been developed to the extent that the reception of signals is possible from the powerful continuous-wave transmitters in Germany, 4000 miles away. When the loop aerial is used, it becomes feasible to determine the direction from which signals are coming; with two loops at right angles, and a variable-phase receiving transformer, rapid measurements of bearing can be made. At Union College there has also been some work done in the development of these small receiving aerials. Messages from stations all over the United States have been received, according to our reports, and there is said to be less difficulty from atmospheric and other interference than when the usual tall aerial is used. Manifestly, if small wire arrangements located within doors can be used with equal effectiveness, in place of the tall structures usually resorted to, considerable economies of installation and maintenance should result.

So far as has been disclosed, there is no radical change in the indoor aerials now under test as compared with those tried in past years. The amount of energy abstracted from the passing electromagnetic wave is small when considered in its relation to the power which would be developed by the same wave in a high antenna-wire. In spite of its feebleness, however, the received impulse can now be utilized to produce an indication, because of the availability of recently-developed vacuum-tube amplifiers. Signal effects so weak as to be entirely lost by the radio receivers of five years ago can now be built up to sufficient strength for easy telegraphing.

The vacuum relays are particularly suitable for use in conjunction with small receiving aerials, for the tiny absorbing systems are not subjected to the severe atmospheric impulses which play havoc with amplifying receivers as ordinarily used. Thus it is possible to take advantage of high powers of magnification, and to secure signals of commercial intensity without too much trouble from stray interference. Directive receiving tends to minimize the harmful effects of vagrant signals, and to some degree those of atmospherics. As a whole, the indoor antenna appears to be distinctly practical; and the opportunities it offers for concealment should make its use of marked military value.

Outdoor Installations

THE outdoor substation is an effective protest against unnecessary expense. Since the very outset of high-tension work it has been almost universal experience that difficulties much feared in the beginning have vanished as they have been met and the enormous and costly precautions of earlier years have proved to be in great measure quite unnecessary. Progressive engineers are looking for simplicity and the elimination of unnecessary expense, rather than for imposing structures and a degree of "flexibility" which is totally unnecessary for most practical purposes. It is even a question whether it is not wise to consider in present-day practice a generator and its transformer as a single unit, and to abandon the extremely complicated and expensive switchboard equipment necessary to provide for interchange of any transformer with any generator. One does not attempt to arrange generators and water wheels so as to be interchangeable, and there seems to be no better reason for so dealing with the transformer.

Two questions arise with respect to using high-tension transformers out of doors. First comes the matter of properly insulating the terminals. This has been attended to by the transformer manufacturer so skillfully that very little difficulty is heard from this source in using transformers out of doors. Second, comes the matter of proper cooling. Indoor transformers are very generally water-cooled by circulating water through cooling pipes in the transformer case. This is perfectly practicable for transformers set up in the open provided water supply is at hand, as it generally is if for any reason this equipment is considered desirable at the generating station. In outdoor substations there is often no water available and no attention to insure that the cooling system is functioning properly. Hence there has been an evolution of radiator type transformers in which the natural air cooling is sufficient for the disposition of the heat. The automatic radiation generally depends on very deep corrugations in the exterior surface of the case so as to give adequate radiating power for cooling the oil within. In more recent designs interior pipe flues are arranged to serve the same purpose, and probably a combination of the two methods would give the most satisfactory results since the inner tubes can be arranged to get at the deeper portions of the oil with good effect. Self-cooled radiator transformers are being built with ratings as high as 8000 kva. in which the radiators attached to the tanks provide a cooling surface of about 10,400 sq. ft. Mr. Samuels' suggestion that the transformers should be mounted on wheels and set on rails so that they can be shifted into a shelter house for examination and repair is a good one, although in some cases a still cheaper arrangement would be to set the transformers far enough

apart to permit erecting a canvas shelter supported from the gin poles carrying the lifting tackle.

Switching arrangements have likewise been simplified and improved of late. Oil switches provided with suitable terminals can be safely installed out of doors and connected if desirable to automatic overload switches as successfully as if they were indoors. Ordinarily such oil switches are manually operated except for automatic trips, but when the transformers are located near the generating station as sometimes is the case, especially in increasing equipment, the switches can be worked by remote control in the usual manner. All such switches should be provided with hand levers whether indoors or not. Now and then, as Mr. Samuels suggests, it may be necessary to work an outdoor substation by remote control over a considerable distance, and then a control cable can be run from the power house and made to serve all the purposes required. It is worth noting that the air-break switch has found large use in outdoor substations and has done very good work, and the recent type of combined oil and air-break switch in which the initial break only is under oil serves its purpose admirably.

A substation with all this equipment, and the necessary disconnecting switches and lightning arresters sometimes looks extremely complicated, but it need not be so in reality unless it is attempted to make it unnecessarily compact. When moved out from under the roof compactness is a very small virtue, particularly when operation can be made more convenient and certain by taking a reasonable amount of room. Lightning arresters even of the electrolytic type are now very commonly installed out of doors and have been found to do good work. Of course, some extra cost is entailed in equipping the apparatus for work in all kinds of weather, but this expense is so small compared with that of building an elaborate transformer and switch house that there is little temptation to put money into architecture rather than equipment, particularly in the milder climates of our country. It is interesting, however, to note how successful outdoor substations have been even in the northern United States and how necessary they are to meet the requirements of a widespread network including the service of many customers of relatively small demand. We can commend Mr. Samuels' article most heartily to those progressive engineers who are vitally interested in keeping up efficiency and keeping down cost at the same time. It is not under all circumstances or in every locality that outdoor substations are desirable, but there is going to be a great extension of their use, producing a most wholesome tendency toward simplicity in equipment and distribution.

Rolling Mill Motor Generator Sets

IT is impossible to watch the operation of a rolling mill working on steel billets without being impressed with the changeability and rapidity of fluctuation in the load. The power or rate of delivery of energy may be great; but the rate of change of the power, or the second derivative of energy with respect to time, is often astonishing. Our technical language is lacking in terms to express briefly and adequately this property of power fluctuation, which is nevertheless of great consequence to engineers, and which bears a similar relation to power and energy that acceleration bears to velocity and distance. It might be called "impulsiveness," in lieu of a better term.

In an article we published a few months ago, William Knight indicated that in dealing with rolling mills of large impulsiveness, or subject to fluctuations of thousands of kilowatts per second, a low-efficiency induction motor with auxiliary flywheel might be much more effective than the same plant with a high-efficiency induction motor; because a high-efficiency, low-resistance motor, when overloaded, tends to draw heavily on its supply mains during the overload, and not to make a large demand upon the kinetic energy in its flywheel; whereas a higher-resistance induction motor, with larger slip under load, tends to slow down under overload, and, in so doing, to draw more heavily upon the kinetic energy store of the flywheel. Formulas and curves were given in that article to aid in the design of such a flywheel-motor set, capable of carrying a given average load impulsiveness, and range of load, without overloading either the motor or its mains. In this number, Mr. Knight discusses the same principles with the aid of a new graphical method, whereby the amount of necessary computation is considerably reduced. The method suggested will be of interest to electric rolling mill designers and operators.

The Coming Issues

NEXT week, in the commercial issue of the ELECTRICAL WORLD for December, among other articles bearing on the development of central station business will be several taking up the subject of electric heating as a means of straightening the customer's load curve. Supplementing the general discussion one author describes an experiment in house heating by electricity, comparing the cost observed with that for heating by coal. In another article, data on the maximum demand of large business buildings is presented with the suggestion that such actual demand be used as a basis for rate making. The promotion of the export trade of American electrical manufacturers is discussed in a leading article planned for the same issue, in addition to which there will appear the regular departments for the engineer and operating man. In the issue of Dec. 30 a feature article on a graphical method for the calculation of busbar sizes will include charts for direct computation of conductors. The editorial program for the ELECTRICAL WORLD'S annual review and statistical number, dated Jan. 6, includes a group of articles by representative authors, on developments in the industry, together with a statistical analysis of 1916. The December number of the new monthly publication, ELECTRICAL MERCHANDISING appeared on the fifteenth of the month, and to it are referred commercial readers interested in detail selling methods.

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

NIAGARA DIVERSION FOR CONGRESS TO DECIDE

Secretary of War Baker Refuses to Take Action, Stating That He Lacks the Necessary Legal Authority

Arguing that except under the provisions of the general dam act and that by an uncertain, if not strange, construction, the Secretary of War has no legal authority in the matter of authorizing additional diversion of water from the Niagara River for power purposes, Secretary Newton D. Baker has refused to take action in the matter and has left the granting of temporary permits to Congress.

The Secretary of War having refused to take action himself has recommended that temporary permits be given to generate more power at Niagara Falls and has also advised Congress that in considering its legislation as regards further diversion it should keep in mind the preservation of the Falls by actually diverting more water.

ELIHU THOMSON RECEIVES THE JOHN FRITZ MEDAL

Homage Done Him in Boston—E. W. Rice, Jr., Reviews His Work as an Inventor and Scientist—Tribute of President Maclaurin

In the presence of a distinguished gathering of engineers, scientists and other guests, Prof. Elihu Thomson, past president of the American Institute of Electrical Engineers, was presented with the John Fritz Medal "for achievements in electrical inventions, in electrical engineering, and in industrial development and in scientific research," at Boston, Mass., Dec. 8. The medal was awarded to Dr. Thomson in January, 1916, and its presentation concluded the program of the 327th meeting of the A. I. E. E.

The exercises took place in the central lecture hall of the Massachusetts Institute of Technology, at Cambridge. It is a coincidence that within a week Dr. Thomson has also received the Hughes Medal of the Royal Society of London, "for investigations in experimental electricity." Prof. Albert Sauveur of Harvard University, representing the American Institute of Mining Engineers, and chairman of the John Fritz Medal Board of Award, presided. John J. Carty, chairman of the Presentation Committee of the Board of Award, delivered the first address, in which the history and purpose of the medal were reviewed. Among its recipients have been John Fritz, Lord Kelvin, George Westinghouse, Alexander Graham Bell, and Thomas A. Edison.

THOMSON A PROLIFIC INVENTOR

E. W. Rice, Jr., president of the General Electric Company, and intimately associated with Dr. Thomson for the past thirty-six years, made the chief address giving a masterly review of the life-work of the guest of honor, with a glowing appreciation of his contributions to the material and intellectual wealth of the world. Characterizing Professor Thomson as one of the world's most prolific and industrious inventors and scientists, the speaker pointed out that over 550 electrical patents have been taken out by Professor Thomson in the United States alone, the total number of his patents in this country being about 700. Several hundred articles of great interest have been contributed by him to scientific, engineering, and other publications.

Among the 600 electrical patents issued to him the more important are for the following inventions: Thomson-Houston arc systems, dynamos, regulators, arc lamps (chiefly of the shunt type), etc., 1878-1884. Magnetic blow-out switches, controllers, lighting arresters, begun in 1881. Many improvements in transformers; he ran two in parallel at the Franklin Institute in January or February, 1879. Reactive coils, 1883-1884. Grounding the secondary and the use of a grounded shield in transformers, 1885. (The patents of this general line were dedicated to the public by the owner on the ground of public safety so that there should be no difficulty in applying them universally.) Original forms of counter distorting series fields for constant potential dynamos, 1885. Electric welding first brought out in 1886. Discovery of the principle of alternating current repulsion apparatus, 1885. Repulsion motor based thereon, 1887. Alternating current phenomena of the shifting field discovered early in 1888. Shaded pole motors, 1888. Constant current transformer of the fixed coil type, 1888; movable coil type, 1893-1894. Electric meter started in 1885 brought out in 1889; for which he received the Paris prize in 1890 (4,000,000 Thomson meters have been sold and are now in operation). Alternating-current induction regulator which is the basis of those used later in electric furnace work, etc. Oil transformers, water-cooled transformers, patented in 1890 and 1893. Astatic and inclined coil type of measuring instruments, 1895-1896. Originated the X-ray stereoscopic pictures, 1896-1897. Induction meter, 1897; this was the basis of the more recent types. Multiple unit train control, master controller and contactor system; the basic patent on this subject worked out some years before 1899. Dynamo static machine, 1898-1899. Pioneer high-frequency work about 1890.

In the mechanical field, Professor Thomson has patented a uniflow steam engine of high efficiency, an automobile muffler, numerous gas and oil engines, and other apparatus; while in the fields of optics and acoustics his achievements mark the hand and mind of the master. Professor Thomson's dedication of patents relating to the grounding of transformer secondaries to the public, in the interests of safety, was also mentioned. Various important researches closely related to his inventions were referred to by the speaker.

HOW THOMSON WORKS

"His inventions," said Mr. Rice, "are not those of the happy-go-lucky kind, but are the result of careful and thorough research. As a close observer of Professor Thomson's activities for over thirty-six years I may be able to say something of interest as to his method of work. A skilled workman, he is always able himself to do the work which he asks others to perform. He prefers to make his own drawings, free-hand sketches, to which he adds dimensions and a short written description. He selects his own materials, supervises the work, quickly makes such modifications as may be needed dur-

ing its progress, and stands ready to give just the advice necessary to help over difficult places and turn failure into success. His inventions are the result of such profound and accurate knowledge and developed with such skill that they almost invariably work on the first trial in accordance with expectation.

"One of the most extraordinary things about his experimental work is its low cost. I am sure that if a prize were to be given for the inventor or engineer who could make a dollar go farthest and produce the greatest results, Professor Thomson would have no worthy competitor in this or any other country, and I say this because I have had some experience with other inventors! (Laughter.) He seems to possess an almost intuitive insight into Nature and her ways, probably because of the quickness and accuracy of his perceptions combined with the most remarkable depth and range of his scientific knowledge, all helped by a marvellously retentive memory. In fact, Professor Thomson, perhaps more than any other inventor since the days of Henry and Faraday, combines in his person profound and accurate scientific knowledge with extraordinary technical skill.

"It is difficult to restrain our enthusiasm for one who has given the world so much; who has been and still continues to be, such an inspiring example to all workers in science and industry. If I have failed to use superlatives, it is not because they are undeserved, but in deference to his well-known modesty and because of the conviction that a plain statement of facts would be most impressive. His technical and scientific work has met with the enthusiastic approval of his fellow men as evidenced by the honors of all kinds that have been showered upon him, but I think that those who know him best prize not only his technical skill and scientific attainments but those qualities—ethical if you please—with which he is so generously endowed; those qualities which make the personality of the man we delight to honor so sincere, so full of sympathy with all that is good in life; that character which commands our confidence and respect and wins and retains our affection. It strikes me as a peculiarly happy and sensible thing to do to honor such a man while he is in the prime of life; it gives double pleasure to those who join in the fortunate event and to the one who receives the token of appreciation. While our friend perhaps considers the joy which he has had in his work as a sufficient reward, let us hope that the joy and satisfaction may be increased by the many evidences of appreciation of a grateful world of which the medal to be bestowed to-night is the latest but by no means the least or the last."

THOMSON AS AN EDUCATIONAL FORCE

Pres. Richard C. Maclaurin of the Massachusetts Institute of Technology spoke of Professor Thomson as an educational force of the highest potency and said that no one in the world has made more notable contributions to the electrical art. "Thomson has admittedly been transcendent in the field of economical invention," said the speaker, "and few inventors have his power of correlating a whole series of inventions. The public is handicapped by Professor Thomson's modesty and his incapacity and disinclination to advertise himself in the slighest degree. He is the last man in the world to take any credit to himself for what other men have done." Closing, Dr. Maclaurin emphasized Professor Thomson's wide range of interests and appreciation of scientific methods and development, declaring that the medallist is worthy in every way to be placed among the great names hitherto named in the awards.

Dr. Charles Warren Hunt, past chairman of the Board of Award, and representing the American Society of Civil Engineers, then conferred the medal, the audience rising as Dr. Thomson stepped forward to receive the decoration and diploma.

In a brief but heartfelt response, Dr. Thomson expressed his appreciation of the honor and said, "The John Fritz medal is more than usually significant. Joy of accomplishment has been the immediate recompense of the work. Others have shared in it." He then paid a tribute to the assistance of Mr. Rice through many years. At times heavy burdens and discouragements have been experienced, but these stir the true investigator to greater effort. Above all things the investigator must possess the unquestionable spirit of optimism. Not the least part of the satisfaction of the work has been the opportunity to help others. To young men Professor Thomson said in closing that if the way seems long, the obstacles many and self-denial extreme, success may be won by enthusiasm, the habit of constant thought and the determination to regard difficulties only as stepping stones to victory.

REVISION OF THE BOILER CODE

Autogenous Welding, Stamping of Boilers and Use of Fusible Plugs Discussed at Public Hearing in New York

Electric welding, labeling of boilers and use of fusible plugs were the subjects most extensively discussed at the recent A. S. M. E. boiler code hearing held in New York on Friday and Saturday of last week. The advocates of electric welding believed that its merits should be recognized by the code. To assure proper welding, however, it was suggested that welders be licensed and that firms using them be certified. The point was brought out that if electric welding is not recognized by the code its development will be considerably retarded. Objections to autogenous welding were made on the ground that overheating is liable to occur, that cast steel is deposited instead of a fibrous metal, and that the metal crystals on each side of the weld are enlarged, thereby weakening the plate welded. It was pointed out by a speaker who had made an extensive study of electric welding, however, that if metal is properly welded by electricity the joint may have as desirable or more desirable characteristics than the material welded and the objectional crystalline growth may be prevented. Results of tests and photomicrographs of welded joints were shown to confirm this statement. It was quite generally admitted that electric welds may be allowed for repairing leaks and for welding joints that will not be subjected to excessive strains.

Stamping of boiler pressure ratings by the manufacturer with the date of placing in service was favored by some, since it affords inspectors a basis for rating boilers at subsequent times and plainly indicates to the user the maximum pressure which can be allowed when new. Furthermore, it would assist in placing the blame when boiler explosions occur.

Arguments for and against fusible plugs were brought out in considering the revision of the appendix to the boiler code. Attention was called to the fact that they are not used abroad, whereas, on the other hand, the United States Navy requires them. When used in Massachusetts they must be changed once a year to assure their reliability. While some speakers contended that fusible plugs are not reliable, others pointed out that at least they constitute an additional indicator of trouble and should be required. In this connection it was pointed out, however, that while safety

is the first and last consideration in revising the boiler code unnecessary hardships should not be thrust on boiler users.

Among other subjects discussed at this hearing were the following: Elimination of copper specification for boiler plate steel, changes in bending test for same, changes to make flange and firebox steel-tension requirements the same, elimination of boiler-rivet yield point, changes in flange test for lap-welded and seamless boiler tubes, elimination of lap-riveted joints in longitudinal boiler joints, methods of figuring efficiency of riveted joints and ligaments, and safety-valve requirements.

INSULL OPPOSES HOME RULE

Prefers State Board Where There Are Fewer Minds to Deal with for Utility Regulation

Samuel Insull, president of the Commonwealth Edison Company, Chicago, told Congressman-elect Medill McCormick's Illinois State legislative committee on Dec. 11, that he preferred a state commission to either "home rule" or the Chicago City Council in control of public utilities. He stated that the control of public utilities, or the regulation thereof, should be an economic, not a political, question, pointing out that the whole tendency everywhere throughout the world in such matters is to centralize the regulating power, and that where regulation of utilities is delegated to a small body the results are much more satisfactory and beneficial, both for the companies and the public.

Mr. Insull said the present Illinois Public Utilities Commission had not always agreed with him and, in some instances, had made it difficult for his companies to go along, but that on the whole the services of the State commission, both to the companies and the public, had been much more beneficial for everybody than the action of scores of local bodies could have been. He plainly indicated that he did not believe Chicago would gain anything for the people by the so-called "home rule" proposed by civic bodies and politicians. If the Legislature, however, deems it wise to delegate to Chicago absolute power in regulating utilities in Chicago, he said he preferred that the local commission be named by the Mayor with the consent and approval of the City Council, but would look with disfavor on the proposition to give the City Council the control of such commissions.

INDICTED FOR FRAUD

Philadelphia Brokers Swindle Investors in Gas and Electric Utility Securities

A federal indictment charging conspiracy and using the mails to defraud investors out of hundreds of thousands of dollars has been returned against Clawson Bachman and J. T. Hayden of Philadelphia, and A. H. Nissley of Steelton, Pa., comprising the firm of Bachman & Company, investment brokers, which is now in the Bankruptcy Court.

It is charged that the defendants defrauded hundreds of persons through stock subscriptions in the International Gas and Electric Company, a Delaware corporation, by representing that seven subsidiaries were earning sufficient profits to enable the International, the holding concern, to pay 6 per cent dividends. It is further charged that dividends were paid out of the stock subscriptions and that in some instances the defendants regained the dividends by inducing shareholders to reinvest in new stock.

The subsidiaries, according to postal inspectors, are the Concord (N. C.) Gas Company; Georgetown (S. C.) Railway & Light Company; Syracuse Suburban Gas Company, East Syracuse, N. Y.; Gaston County Gas Company, Gastonia, N. C.; Georgetown (S. C.) Gas & Electric Company; Newbern (N. C.) Gas Company, and the Goldsboro (N. C.) Gas Company.

READJUSTMENT OF ALL NEW YORK CITY RATES

Public Service Commission Sets Date for Hearings on Queens Borough Gas & Electric's Schedules Preparatory to Reduction

The Public Service Commission for the First District of New York has decided to investigate the rates charged for electric energy by the Queens Borough Gas & Electric Company which serves the Rockaways section of Queens. The investigation is undertaken in the effort to see if it may be possible to secure reductions for consumers. The first hearing was held on Dec. 11.

The company has a maximum rate of 13 cents per kilowatt-hour, and furnishes both gas and electricity to residents of the section mentioned as well as for other communities adjoining New York. The pending investigation, however, has only to do with the electric rate in the localities served by the company within the city of New York, which is as far as the jurisdiction of the Public Service Commission for the First District extends.

The contemplated hearings follow a long series of conferences between Commissioner Whitney and officials of the company in which effort was made to secure voluntary reductions in both gas and electric rates on the part of the company. These conferences failing of the desired result, however, the commission ordered the hearing in respect of the rate mentioned.

The commission on Dec. 4 began hearings as to the rates charged for electricity by the New York & Queens County Electric Light & Power Company, the only other company furnishing electric current in Queens Borough. Reductions have been brought about in the schedules of the three other companies serving Greater New York City.

VALUE OF HOLDING COMPANY TO LOCAL UTILITY QUESTIONED

Illinois Commission in a Recent Decision Speaks Plainly Regarding Increased Compensation for Services Rendered

The recent order of the State Public Utilities Commission of Illinois, in the case City of Lincoln *vs.* Lincoln Water & Light Company (2496), exhaustively treats of several important phases of the valuation of public utility property for rate-making purposes. The primary question involved is what are the fair and reasonable rates of charge for electric and water service in Lincoln, Ill.—a city of approximately 10,000 population. Although the aggregate amount of the valuation is relatively small ($325,000), Commissioner Walter A. Shaw, in the opinion rendered, has delved into the divers theories and principles underlying scientific rate-making, and the opinion is plain-spoken in its admonitions to utilities to play fairly and to meet squarely the modern situation of State regulation of public utility property.

After discussing the separate topics of overhead expenses, bond discount, working capital, depreciation, rate of return, etc., Commissioner Shaw dwells at length upon the operating expenses, procedure expenses, and form of the rate schedules.

The decision, while admitting the value of the serv-

ices of a holding company is skeptical regarding its worth in the present case, and is frank in so stating.

It appears that the Lincoln Water & Light Company is a subsidiary of an Eastern holding company, to which $2,000 has been paid annually for the holding company's services. In submitting its normal operating expenses, the utility claimed that the charge made by the holding company should be increased to $3,500 annually. The commission disallowed the increase.

SHALL INVESTORS BEAR PORTION OF EXPENSES?

The commission says: "The charge of $2,000 in no manner can be considered in the light of a strictly good-faith trade between a willing buyer and a willing seller; instead it is an unregulated price, as high as the traffic will bear, as it were, dictated by the party most benefited—the holding company. The expenses of the holding company, however, are real and must be met; but shall these expenses be assessed in full as an operating charge against the public of the city of Lincoln, or should a portion thereof be borne by the investors who reap their gains from the profits of constituent companies?

"In general, money seeking investment entails its cost just as surely as do projects seeking money. The organization of a typical holding company (and for purposes herein it will be assumed that it be a modern holding company, engaged in lawful and proper pursuits) embraces auditors to conduct accounting investigations of subsidiaries, engineers to plan extensions and betterments, efficiency experts to point out operating improvements and refinements, purchasing agents to buy supplies in large quantities at the market's best, attorneys to protect legal rights, financiers to arrange for the always-needed capital requirements of the constituents, and other similar and allied departments.

DIVIDING ALL EXPENSES AMONG PROPERTIES UNREASONABLE

"Undoubtedly, a local utility will receive several benefits in a course of years from a well conducted holding company, and the public of that local community should be willing to sustain payments to a holding company whenever the holding company renders real service and gives value received in the amount charged to the community; but it is nevertheless a fundamental fact that the organization of the holding company is primarily for the protection of the financial interests involved—to render more secure the holding company's investments, to enhance the earnings of the subsidiaries for the benefit of the holding company, and to investigate and report upon, not only the existing subsidiaries, but also contemplated new subsidiaries, all for the ultimate benefit of the holding company. The public of a city served by a subsidiary is not particularly benefited, either directly or indirectly, by several of the holding company's expenditures, and, in general, there can be no logical reason for apportioning all of a typical holding company's expenses among the constituents.

"In the case at bar, the holding company's expenditures have not been presented, and there is no method of ascertaining from the record what portion of its expenses are charged to its constituents, nor of determining what is the system of apportioning the same among the various subsidiaries. Viewing the situation, however, from the benefits which may accrue to the citizens of the city of Lincoln, it is the opinion of the commission that $2,000 annually is a sufficient and adequate operating charge to be borne by the public, under the operating conditions and service consumptions existing at the date of the valuation. It is believed, moreover, that the respondent's present managerial salary coupled with present office salaries plus the said allowance of $2,000 to the holding company would ordinarily be quite adequate, if carefully and reasonably redistributed, to provide for an excellent and full local organization in the city of Lincoln, were the respondent severed from its parent.

"It is not to be overlooked that much of the service customarily rendered by holding company is such as would be properly chargeable to the capital account. Preliminary and legal expense, as well as engineering, may be performed by the holding company, and such expenses are reflected in the overhead allowances made by the appraisers. The charge to operation of $2,000 should not be expected to compensate the holding company for charges which with accurate bookkeeping would be taken up on the respondent's capital accounts; such compensation is inherently contained in the valuation fixed herein. The said allowance of $2,000 must be regarded as compensation for operating services only; and for such services the commission believes the said sum to be quite fair and adequate, particularly in view of the record herein, which discloses that the respondent's operation and management are not so superior to the average run of isolated independent utilities as to warrant large service fees to the holding company."

AUDIBLE RECEPTION OF CABLE MESSAGES POSSIBLE

War Department Announces the Discovery as a Result of Experiments Which Have Been Made on Pacific Coast

The War Department has announced as the result of a number of experiments performed under working conditions on the Pacific Coast under the direction of Lieut--Col. George O. Squier, U. S. A., the discovery of a means whereby cable communication may be received by ear instead of by eye as at present. The official announcement regarding the invention follows in part:

"The prelminary experiments, which have been in progress for some months, were made at the government radio laboratories, and the actual tests on an ocean cable have been completed recently. The improvement consists essentially in the adaptation of the 'ticker' and audion types of instrument used for receiving the signals in radio telegraphy.

"The tests have been made on the Government Signal Corps cable from Sitka, Alaska, to Seattle, Wash., and the receiving apparatus was installed in the Seattle office. This cable is 1086 miles in length and has a K. R. approximately equivalent to one of the Atlantic cables.

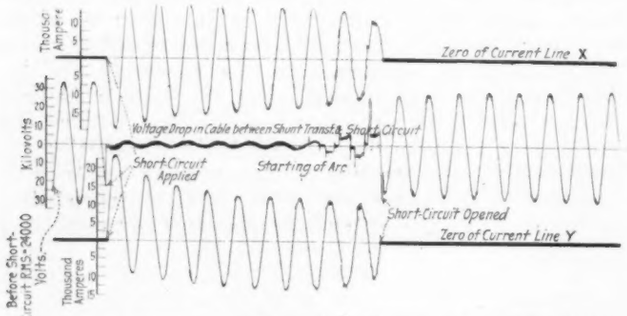
"The actual receiver is an ordinary telephone. The feeble current received is normally inaudible in the telephone. It is broken up by means of a slipping contact 'ticker' and rendered audible. In order to secure greater sensibility, a tuned audion amplifier is used in connection with the ticker. The sensitiveness of this apparatus is so great that less than one-twentieth of the voltage necessary for operating the siphon recorder is sufficient to give good traffic signals.

"The significance of this development may be realized when we remember that at present all the traffic for ocean cables has to be translated into an entirely different code at each end and that highly paid cable readers are required to decipher these messages. The present discovery brings the operation of ocean cables in line with land line telegraphy as well as radio telegraphy. The increased sensitiveness obtained by this method guarantees the operation of ocean cables under conditions when they would be totally interrupted as at present used and forecasts radical improvements in the world engineering practice of cable telegraphy."

INSTITUTE CONSIDERS RATING OF OIL CIRCUIT BREAKERS

Manufacturing Companies Review Their Practices at the Boston Meeting, but Operators Contribute Little to the Discussion

The 327th meeting of the American Institute of Electrical Engineers was held at Boston, Mass., on Dec. 8, the program combining visits to local electrical installations in the morning, a technical session in the afternoon, and in the evening, the presentation of the John Fritz Medal to Dr. Elihu Thomson by the Board of Award, at a meeting of engineers, scientists and guests



TRACED FROM OSCILLOGRAPH RECORD 60-CYCLE, 3-PHASE SHORT-CIRCUIT 142,600 KVA. SYNCHRONOUS CONNECTED LOAD

in the central lecture hall of the Massachusetts Institute of Technology, Cambridge.

Papers on the rating of oil circuit breakers were read at the afternoon session by S. Q. Hayes of the Westinghouse Electric & Manufacturing Company and E. M. Hewlett of the General Electric Company. Mr. Hayes reviewed the phenomena occurring in circuit-breaker operation, discussed the different ratings in modern practice, and recommended that an oil switch should be given a rating on the basis of the maximum safe rupturing capacity it can handle, and that a breaker after opening a short-circuit up to its rating should be immediately reclosable, and able again to open up a similar short-circuit. The author held that a breaker should be capable of opening three successive short-circuits before the contacts need to be repaired or the oil replaced, such short-circuits being as close as two minutes apart.

With alternating-current coils energizing the mechanism direct from the current transformers, large capacity breakers can be made to open in about 0.2 seconds. With the usual shunt trip relays the time of opening is from about 0.3 to 0.5 seconds. As most generators reach the condition of continuous short-circuit current in not over 0.8 seconds, it is figured that a definite time limit of two seconds or less secured through a relay is equivalent to non-automatic service, in respect to rupturing requirements. In the case of unsymmetrical waves, it does not appear that the strain of opening is appreciably different from that of symmetrical waves. On the assumption that the strength of the breaker tops, insulators and fittings may have been properly proportioned to the tank strength and that the speed of opening is satisfactory, the rupturing capacity of an oil breaker may be considered as a function of the tank dimensions.

A recent test illustrated in the accompanying oscillographic curves was made with a total of 142,620 kva. in synchronous apparatus connected to a 60-cycle, 24,500-volt bus. In this test there were successfully interrupted short-circuits having a peak value of 950,000 kva. and root mean square value of 475,000 kva. at the time the contacts opened, both symmetrical values at 24,500 volts, representing the largest amount of power ever used on such a test. The unsymmetrical value of the initial wave of the short-circuit was 50 per cent greater, representing 1,425,000 kva. The short-circuit continued for 6 cycles before the contacts parted and continued for 3 cycles through the arc. The only external effect was a small amount of oil forced out through a defective joint between the tanks and the frame.

Mr. Hewlett emphasized the difficulty of obtaining systematic service tests. He pointed out the influence of other conditions than current value upon breaker operation as equipment increases in size and voltage rating, such as power factor, impedance, physical dimensions of conducting parts. The desirability of specifying requirements more carefully was brought out, some users requiring merely the protection of more costly machinery, while others demand repeated operation of the breaker itself without adjustment or repairs. A kilowatt limit rating seems well adapted to smaller system and industrial substation breakers, but in general the author favored rating breakers on the basis of current in the arc and operating system voltage.

Chester Lichtenberger, Schenectady, N. Y., in a written discussion, stated that if the breaker rating is to be separated from its application, a value of the pressure should be adopted which is independent of the system characteristics.

N. L. Pollard, Newark, N. J., said that the operating man needs a breaker which will stand rupturing a circuit without injury. George A. Burnham, Boston, said that the rating of breakers in amperes per phase at normal working voltage is preferable to a rating involving the term "current in the arc." K. C. Randall, Pittsburgh, Pa., suggested that circuit breakers will be less cumbersome when the relation between detailed design and rating is better understood. L. E. Imlay, Niagara Falls, N. Y., said that more trouble had been experienced with low-voltage than with high-voltage breakers. H. R. Summerhayes, Schenectady, N. Y., pointed out that with greater space allowance, low-voltage breakers can be made as satisfactory as the high-voltage equipments. P. M. Lincoln, Pittsburgh, favored rating on the basis of final rupturing instead of carrying capacity. Prof. C. A. Adams, Cambridge, Mass., advocated a definite rating for each breaker independent of the system. Others who spoke briefly were John Harper, Niagara Falls, N. Y.; H. W. Buck, New York; C. M. Green, Lynn; and J. B. Taylor, New York.

LONG SAULT DEVELOPMENT LOSES IN SUPREME COURT

Upholds Court of Appeals in Decision That Legislature Had No Power to Grant Right to and Under Navigable Stream

The United States Supreme Court, with Justices McKenna and Pitney dissenting, held on Dec. 11 that the decision of the Court of Appeals in the Long Sault Development Company's case presented no question for decision under the Federal Constitution, and for want of jurisdiction dismissed the writ of error. This action was brought by the Long Sault Development Company, to which the Legislature of New York, in 1907, as stated in the Nov. 4 issue of the ELECTRIAL WORLD on page 892, granted rights to the use of the bed of the St. Lawrence River, subject to approval by Congress, against John J. Kennedy and later against Homer D. Call, as treasurer of the State.

The Court of Appeals held that the Legislature had no power to grant to the development company the right to the land under a navigable stream to which the people of the State had a right of ownership for any possible public use.

TERRIFIC INCREASE IN JOBBERS OVERHEAD COST

Uncertainty of Future Market Reflected in Remarks at Meeting of Central Division of Electrical Supply Jobbers' Association

On account of the fact that Middle-Western jobbers have been so exceedingly busy in the last six months, no one was called upon to prepare a paper for presentation at the meeting of the central division of the Electrical Supply Jobbers' Association at Chicago on Dec. 12. At the opening of the meeting Franklin Overbaugh, general secretary of the association, told of the work of the executive committee at a recent meeting. In a short analysis of the present business situation A. J. Selzer of Chicago pointed out that the jobbers' overhead expense is increasing at a terriffc rate. He said the jobbers should realize this situation and should so adjust their prices as to end the year with a net profit at least as great as is obtained in normal years.

The uncertainty of the future market was reflected in the statement of several jobbers who said they were taking no orders for future delivery unless they were certain they could get the goods ordered from the factory at the then existing quotations.

A. E. W. LOCAL ACTIVITIES

Reports Received from Many Communities Show Celebration to Have Been Largely Educational

In cities and towns of every size the week of Dec. 2 to Dec. 9 was celebrated as America's Electrical Week. For the most part the local observance of the week was devoted to an electric show or a display of electric goods with considerable space in the local press devoted to electricity. While the scope of the celebration was enlarged to include hundreds of communities which did not observe the event last year, the character of the celebration varied somewhat from the spectacular to the educational. It was noted that many of the outdoor pageants and parades were missing this year, the efforts of the local electrical interests, in many instances, being centered on educational propaganda in the schools, civic organizations, women's clubs and business organizations.

Reports have been received from a number of the towns in which the week was observed as follows:

Chicago, Ill.—The celebration was for the most part educational. The Commonwealth Edison Company distributed $1,000 in prizes to Chicago high school students for essays on "The Comforts and Conveniences of Electricity in the Home." Contractors were awarded cash prizes for the highest total of contracts for wiring old and new residences under a co-operative plan.

Louisville, Ky.—More than 52,000 persons attended the Electrical Exposition in the Louisville Armory under the management of the Jovian League of Louisville. While the show last year was a record breaker, the attendance and the interest in the show this year, it is reported, excelled the high marks of last year.

Oklahoma City, Okla.—The Oklahoma Gas & Electric Company used a three-story business building for an electric show held in conjunction with dealers and contractors. Electrical appliances occupied the first floor, while the second and third floors were given over to vaudeville and motion pictures, all electrical films.

Hot Springs, Ark.—Electrical and Mardi Gras Week were celebrated together. Each night of the week was given over to a special event, among which was a parade of all the electrical trade of the city, featured by floats telling the story of the city's progress.

Wichita, Kan.—An electrical show was held in the Forum, the outside of which was flood-lighted. Fifty electrical appliances valued at more than $500 were given away in prizes.

Charleston, S. C.—Electrical dealers made displays and agreed on special prices with the result that large sales were reported by all. Full-page advertisements were run in the daily newspapers and local dealers entered window-dressing contests.

Peoria, Ill.—The week was celebrated by a show in the City Coliseum, in charge of the Peoria Electric Club. The show was opened by a parade and the attendance was more than 25,000.

Dubuque, Iowa.—Although Dubuque held a "Prosperity Exhibit and Carnival" during the first week of October, the Dubuque Electric Company and other electrical interests co-operated in booming Electrical Week. Efforts were largely centered in winding up a house-wiring drive, which brought in 243 house-wiring contracts. Full pages of advertising, bought by the central station and five local contractors, announced the week and did much to bring about unusual success of the house-wiring campaign.

FLOOR VIEW OF LOUISVILLE SHOW

Harrisburg, Pa.—A co-operative sales plan by the Harrisburg Light & Power Company and two leading local dealers resulted in the sale of $532 worth of home appliances. Each day of the week was given over to the sale of one particular article, the irons on Monday being the leader, although the cleaners on Friday brought in the largest total of cash returns.

Tulsa, Okla.—The electrical show opened with an attendance of more than 1500 persons. The week brought into the exposition more than 15,000 persons, this being one-fourth of Tulsa's entire population. Page advertisements in the newspapers and a liberal use of America's Electrical Week posters and banners directed attention to the show. Every booth in the show was occupied.

St. Paul, Minn.—All of the electrical interests participated in electrical pages, special window displays and salesroom demonstrations. Department store windows were given over to electrical exhibits. Many thousands of booklets were mailed to users describing the advantages of electrical appliances.

Pittsburgh, Pa.—An electric show unique in character of display—the exhibits grouped according to uses, rather than under the names of the manufacturers—was held in the ballroom of the William Penn Hotel. An electrically operated violin, an electric fountain and a spectacular demonstration of electricity under ex-

tremely high voltage were made. Admission was by invitation. On Thursday night, Dec. 7, the Pittsburgh Jovian League held an electrical novelty dance in the Fort Pitt Hotel. The annual banquet of the Pittsburgh section, American Institute of Electrical Engineers, was held in the Fort Pitt Hotel, Saturday.

Trenton, N. J.—An electrical show was held in the Masonic Temple, under the auspices of the Trenton Electrical Company. The attendance was to full capacity every night and the sales made by the exhibitors were far in excess of anticipation.

Pueblo, Col.—The Arkansas Valley Railway, Light & Power Company held an electrical show on the ground floor of its new office building. Novel indoor and outdoor features advertised the show, one of the street features being a talking lamppost located on Main Street, across from the show. This machine was connected with a phonograph in the company's office and selections from grand opera, political speeches and lectures on electricity were heard by crowds in the street. A very large number of sales is reported.

New Haven, Conn.—Charles F. Scott, professor of electrical engineering, opened the Yale University Laboratory for a public exhibit of electrical appliances.

Washington, D. C.—Thousands of people lined both sides of Pennsylvania Avenue and watched a procession of more than 300 automobiles, each elaborately decorated and brilliantly illuminated with electricity, pass down the streets. Prizes had been offered for cars making the best appearance in the parade. An electric show was held during the week, at which the attendance was record breaking.

Philadelphia, Pa.—Transcontinental telephone talks between officials of local electrical concerns and those on the Western coast, elaborate lighting displays throughout the city and illumination of the City Hall tower and various city high schools were features of the celebration in Philadelphia. Along Market, Chestnut and Walnut Streets show windows were brilliant with electrical decorations. Silver cups were awarded by the Philadelphia Electric Company to the firm showing the best electrically lighted windows. This company's power plant at Twenty-eighth and Christian Streets was thrown open to visitors for the first time.

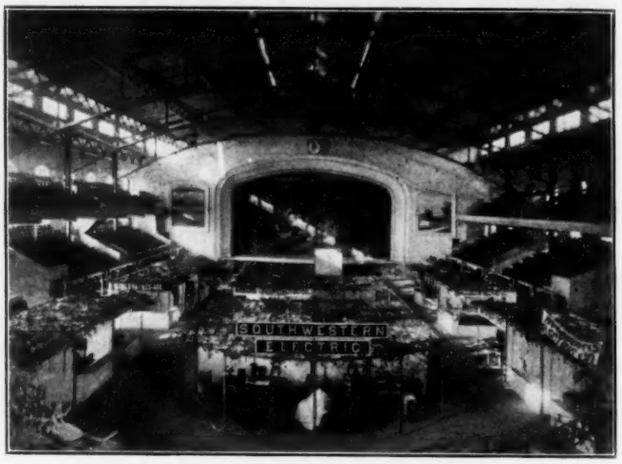
Pacific Coast Celebration

Seattle, Wash.—The electrical show included twenty-five exhibits, and covered over three times the floor space required last year. The exhibitors report that the attendance was greatly increased over that of last year, and the visitors showed a much keener and more intelligent interest in the electrical equipment on display. Of prime interest to the visitors at the show was the cooking and heating apparatus, particularly the new electric ranges.

Portland, Ore.—During the show in Portland, the Portland Railway, Light & Power Company and the Northwestern Electric Company threw open their city plants and substations for public inspection. During the week the Northwestern Electric Company produced the illuminating steam curtain on the roof of the Pittock Block, a feature of last year's celebration. Colored electric flood-lights totaling 20,000 cp. were used in producing the gorgeous rainbow effects. One of the features of the show in Portland was the huge Christmas tree, erected on a busy street corner, attractively illuminated with multi-colored incandescent lights. All of the large cities of the State, including Tacoma, Spokane, Everett, Bellingham, celebrated the week in shows, electrical decorations and displays, featuring the latest electrical appliances and equipment.

San Francisco, Cal.—In order to stimulate the greatest possible interest in electrical matters during Electrical Week, an electrical show was held. One evening was given over to each electrical organization. A total of about 25,000 visitors, it is estimated by the committee, attended, this number being about three times as many as had been expected. As a result of this general response to the publicity campaign, the committee has formulated ideas for more effective handling of large crowds at next year's show.

Los Angeles, Cal.—A general advertising campaign was the means used to bring Electrical Week to public notice. Individual firms carried special newspaper advertising. Department and housefurnishing stores arranged window decorations featuring electrical goods and electrical stores and central stations kept the Electrical Week poster prominent in the public eye by using it on billboards, street cars and delivery automobiles.



GENERAL VIEW OF WICHITA SHOW

The Week in New England

So busy are the central stations of New England this year that the inauguration of National Electrical Week has in many cases seemed like the heightening of an already intensified output of energy and appliances. The pace has been let out a few notches, extra illumination and advertising have been pressed into service, and the rapid approach of the Christmas season has been generally utilized as a timely opportunity for sales increase. The use of the Society for Electrical Development's posters was well-nigh universal among the progressive companies, and distinctive newspaper advertising, street car cards, window displays of taste and brilliance, the special labeling of delivery trucks and circularization of customers were features of the week. Reductions running in some cases as high as 25 per cent of the regular price of appliances were in vogue and even in cities where the rush of regular business preclude elaborate demonstrations, central stations, contractors and jobbers co-operated in the publication of full electrical pages in the local dailies. A vigorously staged electrical show is on at Pittsfield, Mass., the opening lecture being given Dec. 4 by W. A. Whittlesey, manager of the Pittsfield Electric Company on "The Distribution of Energy In and About Pittsfield." At Worcester, Mass., the New England Power Company (hydroelectric) and Worcester Electric Light Company joined hands with local contractors to produce an effective electrical advertising page; the Boston Edison Company, Brooklyn Edison Company and others too numerous to mention are temporarily offering appliances at reduced rates, and in general an active interest is being taken by the electrical trade of New England in the opportunities of this period and their significance for the days immediately ahead.

Outdoor High-Tension Arrangements and Construction

Transformer Cooling Problems, Remote Control of Outdoor Switches, Arrangement of Lightning Arresters and Developments in Air-Break Switches

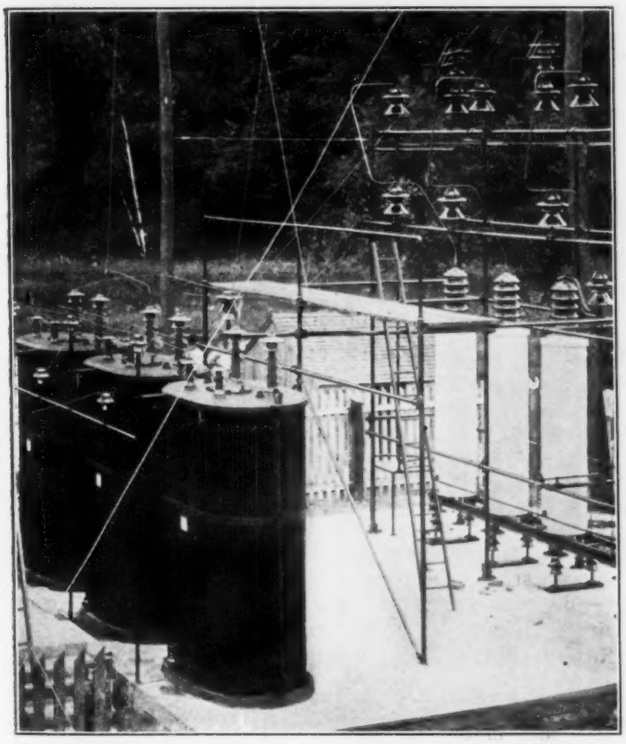
BY M. M. SAMUELS

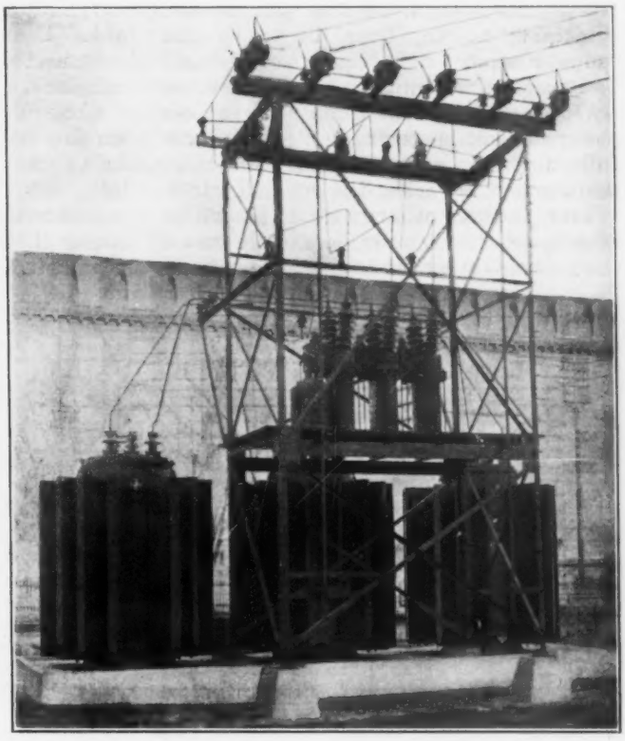
WHILE the development of indoor apparatus has advanced to such a point that there is some uniformity in the appearance and arrangement of equipment used for similar purposes, not so much can be said of outdoor apparatus such as transformers, switches, measuring and protective devices and the like. Safe and effective forms have been worked out, but so many different ideas are being developed that nearly every new piece of outdoor apparatus is different from preceding types intended for the same purpose. In what follows here some of the features of apparatus that have been successfully used are outlined and the difficulties which are often encountered in arranging and constructing outdoor stations pointed out.

The advisability of arranging apparatus outdoors without housing must still be decided in each individual case on its merits. In many cases the saving of insurance, and the investment in a building is offset by the increased cost of outdoor apparatus, while the advantage of eliminating building entrances is lost through the decreased safety of apparatus assembled outdoors. However, the advantages of outdoor stations are so great in other cases that inclosures are not even considered. While the outdoor substation is particularly adapted to Western and Southern conditions, it is rapidly gaining favor with many transmission companies in the East. Even new additions to indoor stations are now being placed partly outdoor. This is especially true of electrolytic lightning arresters, which must be moved outdoors to make room for machinery and switchboard equipment, which must be housed.

Small outdoor transformers have been in use on pole tops for several years, but the station type transformer for outdoor use is a recent development. The principal difficulty in equipping transformers for outdoor service was that of providing suitable terminals. This difficulty may now be considered practically overcome, since terminal troubles are being seldom reported. Cooling methods have not progressed so far, however, but that there is still a good field for development in this direction. In indoor stations the cooling of high-rated transformers is being accomplished by circulating water through the transformer oil.

For outdoor transformers, however, water cooling is not always practical, since units are often located where water is either not available at all or where it can be obtained only at considerable cost. Even when cooling water is obtainable at outdoor stations it is sometimes inadvisable to install water-cooled transformers since there are usually no attendants to see that the circulation of cooling water is maintained and the transformers thus prevented from overheating. If water-cooled transformers were used under such conditions it would be necessary to have the oil switch trip coil actuated by the temperature measuring apparatus or by the discontinuance of water circulation. At present this cannot be considered as a very reliable method, and even if it were it could hardly be desirable since nobody would be present to investigate and remedy the causes of interruptions to service when they occurred automatically. These service limitations have brought about the radiator-

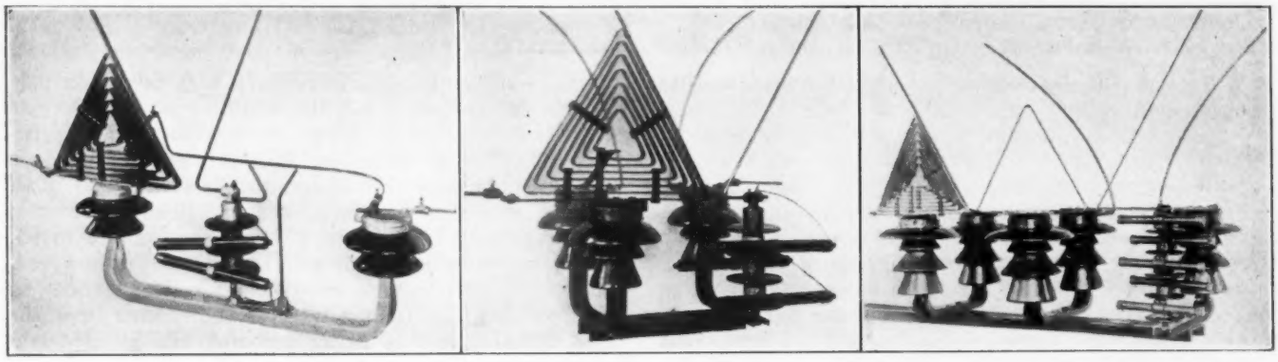




FIGS. 1 AND 2—OUTDOOR INSTALLATIONS OF CORRUGATED-CASE AND RADIATOR-TYPE SELF-COOLING TRANSFORMERS

type of self-cooled transformer, which has several radiator-shape cooling surfaces attached to the tank. The latest types of radiator transformers have exaggerated corrugations on the tanks or a number of 1.25-in. or 1.5-in. iron pipes communicating with the top and bottom of the tank so convection is increased and additional radiating surface afforded.

tion. Such an inclosure should be large enough to house at least one transformer and high enough to permit lifting out the core. These houses should be equipped with the necessary lifting devices, tools and spare parts, and should be built in or near every large outdoor station, since it is not advisable to dismantle a transformer or an oil switch outdoors during a rain.



FIGS. 3, 4 AND 5—25,000, 36,000, AND 60,000-VOLT HORN-GAP ARRESTERS WITH CHOKE COILS, RESISTORS AND FUSES

It is interesting to point out that the largest self-cooled transformer ever made has just recently been completed. It is of the radiator type and has a rating of 8000 kva. About 10,400 sq. ft. of cooling surface (almost ¼ acre) is provided by specially designed radiators projecting radially from the transformer tank. Each radiator consists of three rows of sixteen pipes connected by headers communicating with the transformer tank.

Where outdoor substations are located alongside power houses, however, water-cooling has been successfully used. In such cases care must be taken to place the water pipes below the frost line in sawdust.

Transformers of large rating should be provided with wheels and set on rails, so that in case of trouble they can be rapidly moved into a shelter house for examina-

Outdoor-type oil switches differ from the indoor type mainly in the construction of the terminals and the protection of the mechanism. The terminal problem is practically identical with that encountered with transformers, the present tendency being to increase the height and diameter of the porcelain units. Heavy concrete foundations are gradually being eliminated by mounting oil switches on angle-iron or pipe frameworks, this construction also permitting the installation of tank-lifting and lowering devices.

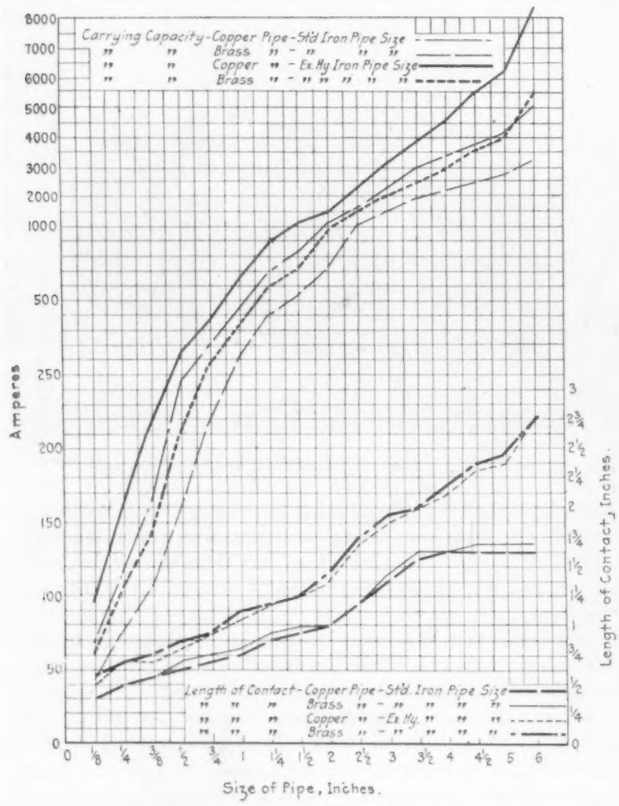

Carrying Capacity-Copper Pipe-Std Iron Pipe Size
" " Brass " - " " " "
" " Copper " - Ex.Hy Iron Pipe Size
" " Brass " - " " " "
Amperes
Length of Contact-Copper Pipe-Std. Iron Pipe Size
" " " Brass " - " " "
" " " Copper " - Ex.Hy. " " "
" " " Brass " - " " "
Length of Contact, Inches.
Size of Pipe, Inches.

FIG. 6—CARRYING CAPACITIES AND CONTACT LENGTHS FOR BRASS AND COPPER PIPES

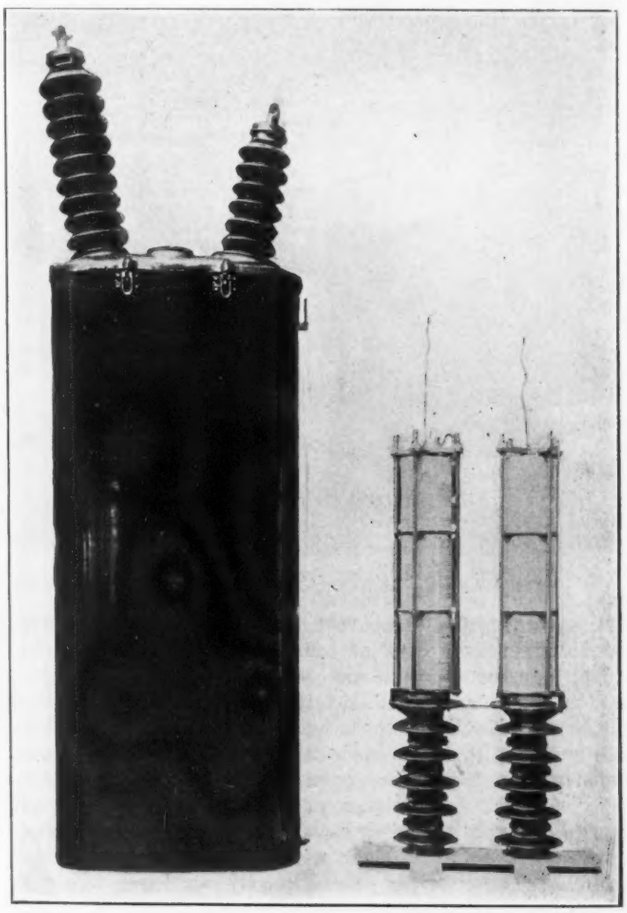


FIG. 7—ASSEMBLED VIEW AND INTERIOR ELEMENT OF 110,000-VOLT ELECTROLYTIC LIGHTNING ARRESTER

When outdoor stations are remote from power houses the oil switches are generally hand operated and equipped with series or shunt trip coils. These are usually operated by the instrument current transformers, but when the latter are not used bushing type current transformers are sometimes installed over the oil switch terminals. When outdoor stations are located

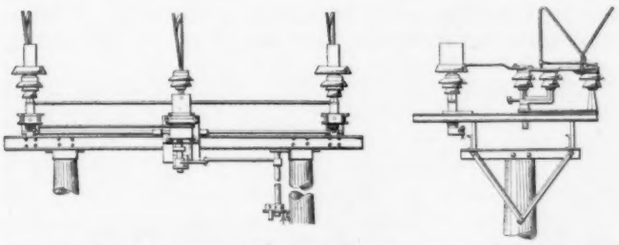


FIG. 8—AUTOMATIC AIR-BREAK SWITCH WITH TRIP COIL IN PIPE MECHANISM

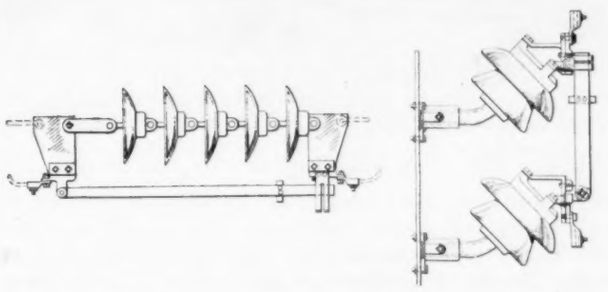


FIG. 9—STRAIN AND VERTICAL DISCONNECTING SWITCHES

near a power house the oil switches should be electrically operated, and controlled from the switchboard in the power house. As few control wires as possible should be used, two usually being enough for operating each oil switch and its corresponding indicating lamps on the switchboard. The oil-switch control leads should be assembled with the current and potential transformer secondaries in one lead-covered cable, which should be run into the power house through underground conning arresters should be connected with each lead of the control cable at the power house and at the substation ends. Usually it is advisable to provide several spare wires in the control cable so they can be substituted for conductors that become unserviceable or employed to supply lighting service to the outdoor station. From

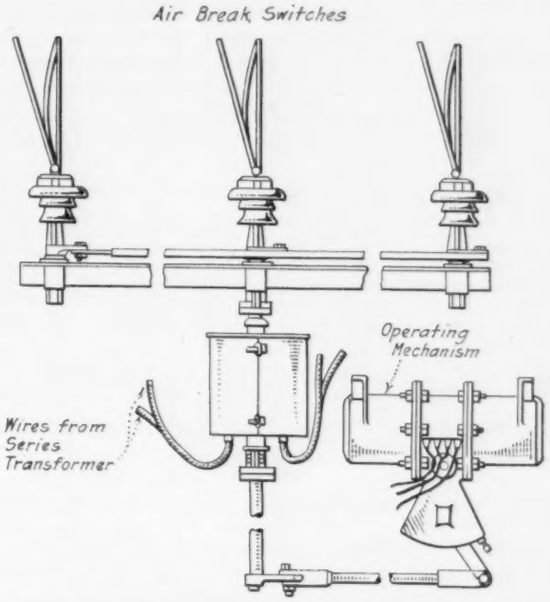
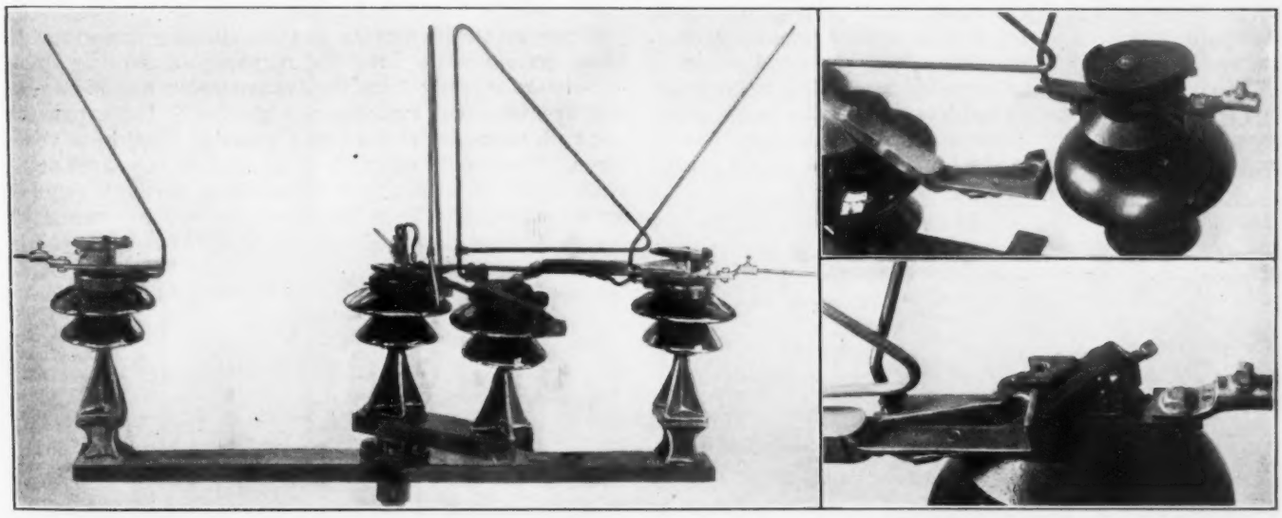


FIG. 10—ELECTRICALLY OPERATED AIR-BREAK SWITCH

the cable entrance to the various points of control, such as oil switches, current and potential transformers, transformer alarms, etc., the control circuits should be carried underground in small iron conduits.

While it is not within the scope of this article to go into the operation of lightning arresters or discuss the question of whether they should be placed outdoors or indoors, it may be pointed out that when installed outdoors they can be placed either on the roof or on the ground. When lightning arresters are placed



FIGS. 11, 12 AND 13—DOUBLE-THROW AIR-BREAK SWITCH WITH DETAILS OF CONTACT DEVICE IN OPEN AND CLOSED POSITION

duits. For emergency use all electrically operated oil switches should also be equipped for hand operation.

Under some conditions it is advisable to control an outdoor station entirely from a power house several miles away, in which case all the control leads can be combined into one cable, which can be carried along the pole line on a messenger wire. In this case small light-

on the roof the horn-gap mechanism and the tank transfer device should preferably be installed inside the building to facilitate operation. Where climatic or other conditions require that the tanks be housed, but where it would be dangerous to have the horn gaps indoors, it may be necessary to mount the horn gaps on the roof even though this arrangement re-

quires two sets of line inlets. In this case the mechanism operating the horn gaps may be inside.

The space required for lightning arresters varies, in each case being greater than the space required for an oil switch. Therefore it will not be possible to arrange a line of lightning arresters opposite a line of oil switches and keep each arrester centered with its line switch without wasting considerable space. However, considering the fact that a line of oil switches will generally contain transformer switches which require no arresters, skillful designers should be able to arrange apparatus so as to obtain direct and straight conductor "runs" without offsets between

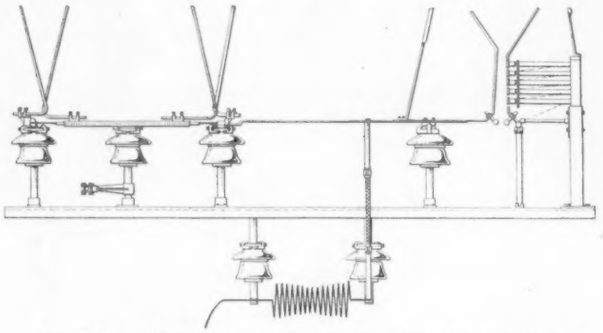


FIG. 14—COMBINED AIR-BREAK SWITCH AND ARRESTER

the line and arresters. This is very essential. If there must be offsets in high-tension wiring they should be made in the "runs" to disconnecting switches, choke coils and oil switches.

Without going into the merits of inserting fuses between horn gaps and lightning-arrester tanks, the writer desires to point out that it not only increases the floor space required for the tanks and horn gaps, but also the operating floor space. Maximum areas that may be safely used for estimating purposes were given in the Nov. 18 issue of the ELECTRICAL WORLD in tabular form. Twenty-five per cent or more can be deducted if non-fused arresters are used. The grounding of lightning arresters should be separated from apparatus grounds, and the ground plate or ground pipes should be installed with great care and all connections protected from injury. An arrester with a poor ground cannot serve its purpose and may cause considerable trouble.

Wire fences should be installed around all electrolytic arresters when installed outdoors, since the tanks must be considered "alive" in most cases, and because it will not be possible to place the tanks above a man's reach.

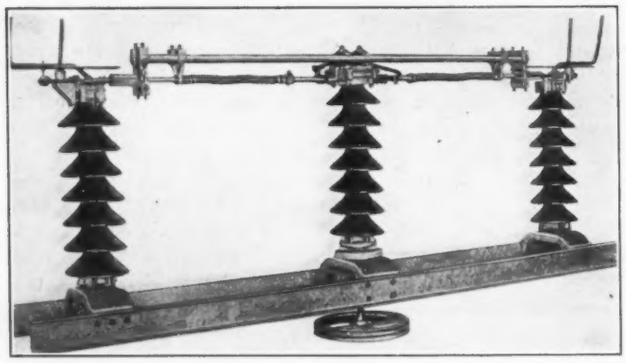


FIG. 16—QUICK-ACTING DOUBLE-AIR-BREAK SWITCH OPERATED BY ROPE

Disconnecting switches, although of secondary importance, are ever a source of worry to station designers. While the width of operating aisles is of less importance outdoors, than indoors, the tendency should be the same as for indoor stations, *i.e.*, to eliminate the switch stick, and operate the disconnecting switches by pipe or chain mechanisms. The remarks made in a previous article on indoor high-tension construction (page 995, Nov. 18, 1916) regarding indoor disconnecting switches also apply to outdoor station equipment, since the same methods of construction may be used in both cases. However, when knife-blade disconnecting switches are used outdoors they should be mounted either in an inverted position or in a slanting position, as shown in accompanying drawings. For very high voltages strain-

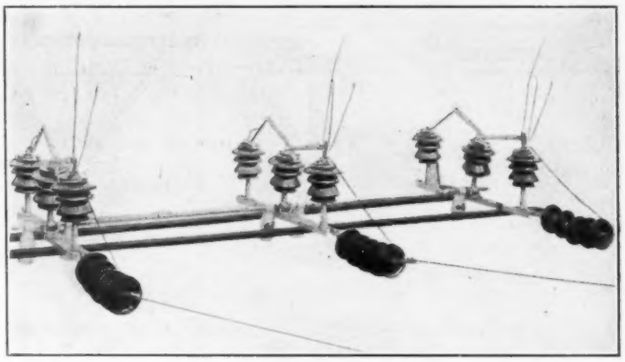


FIG. 15—TRIPLE-POLE AIR-BREAK SWITCH DEAD-ENDING LINE

type disconnecting switches are often used, but in the opinion of the writer this method can and should be eliminated. When strain switches are used, large guide horns should be attached to the jaws of the switch at the clip end, to facilitate closing the switch properly. Switch hooks should be equipped with rain hoods and easily attachable grounding devices. A neat and simply constructed outdoor disconnecting switch which may be used for breaking small loads is shown herewith.

Choke coils offer practically no obstacle to station designers, provided they are taken into account when estimating the required space, and may therefore be passed over at this time. It may be pointed out, however, that it is possible to combine choke coils and disconnecting switches thus saving an insulator.

DEVELOPMENTS IN AIR-BREAK SWITCHES

Since small industries are continually growing up along transmission lines, the necessity of serving small consumers directly from the transmission line is becoming greater. Oil switches are generally too expensive for such purposes, so air-break switches must have their place. Practically all of them operate on the same principle—that of breaking the load first through regular switch jaws, and then breaking the arc by means of horns. Being designed usually for pole-top mounting,

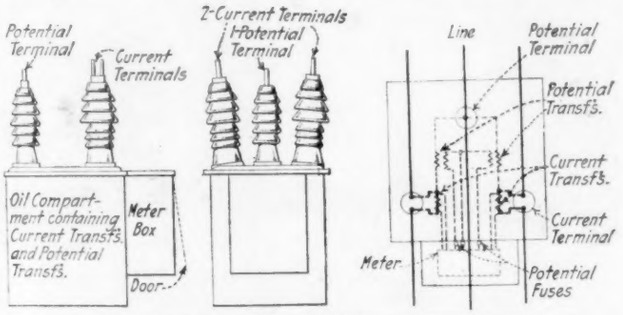


FIG. 18—OUTDOOR HIGH-TENSION METERING OUTFIT WITH CONNECTIONS

they must be placed above all other apparatus. It is not possible to say definitely at this time just how large currents air-break switches can be depended upon to break, but there are cases on record where they have successfully opened circuits carrying 15,000 and even

20,000 kw. in emergency cases. However, when the expenditure is at all warranted oil switches should be used.

Several types of air-break switches that have given satisfaction are shown herewith. Some air-break switches are now being equipped with automatic overload trips, the current transformers being installed on top of the switch insulators, and the trip coils below in the pipe mechanism. This arrangement has a great advantage over fuses. The next step in the development of the air-break switch was to provide for electrical operation. This has been accomplished in practically the same manner as with oil switches. Even when distant control is not required electrical operation is sometimes advisable, since it eliminates practically all hazard and the use of bulky pipe mechanisms. Since direct current is seldom available at remote outdoor substations and since alternating-current magnets are not very satisfactory for switch operation, there is no reason why small alternating-current motors should not be used for operating the oil and air-break switches.

One of the latest ideas in outdoor switching is to combine an oil and horn air-break switch, the initial break being made under oil in bakelite tubes and the final break outside in an air gap. Under test this switch is said to have easily handled the charging current of 150 miles of line and broken a short-circuit on a 5000-kw. generating station. From this it appears that great developments may be expected along this line.

Electrolytic arresters are too expensive for many small customers' stations, so horn arresters are often considered ample protection. Several types of these arresters are illustrated herewith. No rules can be made for the arrangement of pole-top apparatus, since the arrangement will depend upon the pole-top construction of the transmission line, the available pole heights, the available transformers, the ground space and other

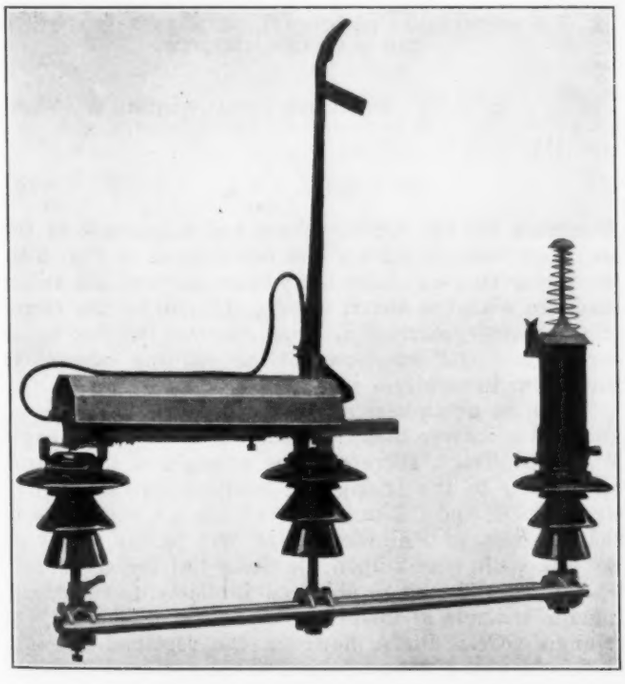


FIG. 19—COMBINED OIL AND AIR-BREAK SWITCH

conditions which are different in each case. About the only rule that can be given is to provide simple wiring and make all apparatus accessible. About the same principles should be observed in wiring outdoor stations as were given by the writer in the Nov. 18 issue of the ELECTRICAL WORLD for indoor stations.

Strain spans and loose suspensions should be avoided as much as possible by using straight, rigid and direct runs consisting of solid hard-drawn wire or preferably copper pipe. The carrying capacity and other data for copper pipe are given in the accompanying curve. There is no reason why an outdoor station layout should be, as it unfortunately often is, more complicated than an indoor station. It is a great deal easier to obtain a good arrangement outdoors than it is indoors if the same principles of design are followed in both cases. Pole-top apparatus will of necessity cause some complications, but these are employed mainly in small stations, so that the difficulties are easily overcome.

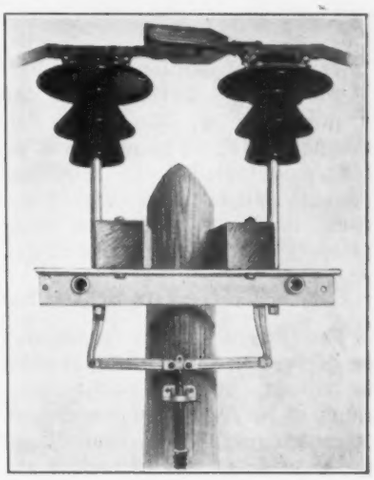


FIG. 20—POLE-TOP DISCONNECTING SWITCH THAT CAN BREAK SMALL LOADS

To protect outdoor installations from lightning the transmission-line ground wires should be continued from pole to pole over the whole station, and all iron work should be grounded. When pole-top apparatus are used ground spans will not be practicable, so lightning rods will have to be employed.

The method of making a ground will depend on the location of the power house. In hydroelectric plants the ground connection can often be attached to the grating at the intake. Two or three pipes driven into permanentiy wet soil will also generally furnish a satisfactory ground if care is taken to properly connect the ground wires to the pipes and protect them from injury. Practically as good a ground as can be obtained can be secured by burying a ground plate in wet soil and surrounding it with pea-size charcoal saturated with salt water. Connections should be made therewith by riveting one or two stranded wires solidly to the plate, spreading the end strands over the whole surface of the plate and soldering thereto. The ground wire may be run to the ground plate either exposed or in fiber conduit. No iron conduit should be used, since a discharge in this case would not be carried along the ground wire to the plate, but along the surface of the iron pipe which is not connected to the plate. A 3-ft. by 3-ft. by 1/16-in. ground plate may be considered ample for ordinary soil conditions. Carbon ground cones have also been used with good results.

When only an ammeter for reading the line current is required the instrument can be made of a series type and mounted on top of the oil-switch terminals provided this does not bring the scale too high above the reading range. When wattmeters are required at least two current transformers and two potential transformers are needed for a three-phase circuit, with a total of six high-tension terminals, which makes a rather expensive outfit. For this reason the combined metering equipment shown herewith was devised. Instead of six high-tension terminals there are only three, this being permitted by installing the current and potential transformers in a common oil compartment. The meters are placed in a side compartment or they can be placed in a separate meter house, since it is only necessary to run low-tension secondary leads from the oil chamber to the meters. Wherever possible meters should be eliminated from the high-tension circuits.

Theory and Operation of Split-Phase Magnet—II

Vector Relations for a Particular Form of Split-Phase Magnet with Open and Short-Circuited Secondary and Practical Considerations of Design and Operation

BY F. HYMANS

IN the first section of this article, which appeared in the Nov. 18, 1916, issue of the ELECTRICAL WORLD, a derivation of the vector diagram for split-phase magnet action in general was presented. The features discussed included the relationship between flux components and exciting current components, phase differences in fluxes with open secondary and reaction of primary on closing of secondary.

III.—THE SPLIT-PHASE MAGNET

The type of magnet for which the vector diagram will be derived in this section is shown in Fig. 7. The core is built up of laminations and consists of two halves clamped in frames of which one is stationary and the other hinged. The vector diagram will be derived for the position of the magnet as shown in Fig. 7, with the hinged arm sealed tight against the stationary frame. At B_1 and B_2 the abutting cores are scraped to a perfect fit, but at A_1 and A_2 a small air gap is introduced to reduce the residual magnetism, so that the hinged arm may freely drop back at the interruption of the exciting current. Between B_2 and B_3 a narrow slot, forming the horns or poles B_1 and B_3, has been cut to receive the secondary.

When the primary is excited a flux is set up of which a part passes through the pole area B_1 and the balance through B_2. The lines of force close in paths somewhat concentric with the axis of the core, and somewhere there must be a line of cleavage which separates the total flux emanating from the primary into two flux bundles of which the outer passes through B_2 and the inner through B_1. The magnetic behavior is consequently such as if the core structure actually consisted of two individual concentric cores, which is emphasized in Fig. 7 by extending the slot for the secondary along the supposed line of cleavage. The actual core structure is thus divided in a core 1 having poles A_1 and B_1, and a core 2 with poles A_2 and B_2, both simultaneously excited by one spool and provided with a secondary on core 1. The identity with Fig. 3 which is hereby complete and the results of Section II may at once be employed here.

With open secondary there will be a flux φ_1 in core 1 and a flux φ_2 in core 2, of which the resultant φ links with the primary. Assuming negligible resistance for the latter, φ will be expressed by

$$\varphi = \frac{e\,10^8\sqrt{2}}{n_p\omega} \qquad (1)$$

Wherein e is the impressed emf., n_p the primary turns, and $\omega = 2\pi \times$ frequency, the angular velocity of the radius vector. When the slot for the secondary is symmetrically disposed as in Fig. 7, the magnetic properties of the two cores, especially with the air gap at A_1 and A_2 become so nearly alike, that for all practical purposes the open secondary fluxes φ_1 and φ_2 will be equal in phase as well as magnitude, each being one-half of φ.

Thus in Fig. 8, the conditions with open secondary are represented by OH, the vector of the total flux φ linking with the primary; $OC = \frac{\varphi}{2}$ the vector of the fluxes φ_1 and φ_2; and OG, the vector of the exciting current, leading by the angle α. At the closure of the secondary, a current i_s will flow through its windings on which the primary reacts in the manner derived in Section II.* Evidently the present case is only a modification of the more general conditions assumed in Fig. 6a, since here the open secondary fluxes are equal and in phase. To apply therefore the results of Section II, we shall have to place therein $\beta = \alpha$ and $\varphi_1 = \varphi_2$. When however, in Fig. 6b, $\beta = \alpha$, we see that triangle GFK becomes a straight line; and instead of triangle GFK of Fig. 6a, we obtain for the conditions of Fig. 8 the straight line FGK, parallel to the vector OU of the secondary current i_s.

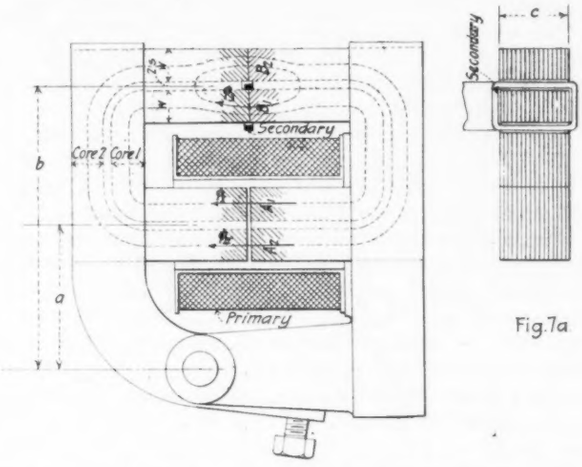


Fig. 7a

FIG. 7—CONSTRUCTION OF SPLIT-PHASE MAGNET FOR WHICH VECTOR DIAGRAM IS DERIVED

For $\varphi_1 = \varphi_2 = \frac{\varphi}{2}$ we derive from equation 6 of Section II:

$$GF = GK = \frac{n_s}{2n_p}\, i_s \qquad (2)$$

Assuming for the present phase and magnitude of the secondary current known and represented in Fig. 8 by the vector OU, we locate the vectors GF and GK in accordance with the above, whence OF will be the vector of the primary current i_p which induces the flux φ_{II} in core 2, and OK the vector of the exciting current of the flux φ_I in core 1.

To derive now phase and magnitude of the fluxes φ_{II} and φ_I, we observe that OG leads OC by the given angle α. To construct, therefore, the triangle of fluxes corresponding to the triangle of exciting currents OGF, we draw OE and CE to include an angle α with OF and the direction of FK, whence OE will be the vector of the flux φ_{II} in core 2 upon the closure of the secondary. The vector OD may be obtained similarly by constructing the triangle of fluxes corresponding to the current triangle OGK. Since, however, the vectorial increase in flux in core 2 must be equal to the vectorial decrease of flux in core 1, it is simpler to make CD equal and opposite to CE, whence OD will be the vector of the flux φ_I in core 1 with closed secondary.

φ_I and φ_{II} would be the only fluxes existing in the magnet, if it was not that a leakage flux occurs, which sends lines of force from one core into the other and

*In the section of this article which appeared in the issue of Nov. 18, the letter c, through a typographical error, was used instead of i to denote current in those cases where the latter symbol appears in this section and the one that will follow.

which is due to the difference in mmf. between the mmfs. which excite the fluxes φ_I and φ_{II}. This is the flux indicated in Fig. 7 by φ_s. Its mmf. is $n_s \times i_s$ ampere turns; it links only with the secondary and is represented in Fig. 8 by the vector OQ, lagging behind the secondary current by the angle ψ. Of interest in a split-phase magnet is of course the determination of phase and magnitude of the fluxes which pass through the poles A_1, A_2, B_1, and B_2 since they are the cause of the magnetic pull. Now at A_1 and A_2, the secondary leakage flux φ_s is zero and consequently the flux at A_1 will be φ_I and φ_{II} at A_2. At B_1 and B_2 the secondary leakage flux is greatest. The total flux passing through B_1, which we will denote by φ_{B_1}, is evidently (see Fig. 7) the vector addition of φ_I and φ_s. Its vector OA is obtained in Fig. 8, by drawing DA parallel and equal to φ_s. Similarly the total flux φ_{B_2} passing through B_2 is the vector subtraction of φ_{II} and φ_s. Drawing therefore EB parallel with and equal to φ_s but of opposite direction, OB will be the vector of the flux φ_{B_2}. The flux diagram of the split-phase magnet is herewith complete. The flux ψ_I induces in the secondary the emf. e_s, lagging 90 deg. behind ψ_I and represented in Fig. 8 by the vector ON. It must have a component $OP = r \times i_s$ in phase with i_s to overcome the ohmic drop, r being the secondary resistance. It further has a component PN 90 deg. ahead of the vector OQ of the flux φ_s, which serves to balance the emf. of self induction, due to the linking of φ_s with the secondary coil. If L is the coefficient of self-induction per secondary turn, and $i_s \cos \psi$ the secondary magnetising current, we have

$$PN = \omega n_s^2 L i_s \cos \psi.$$

The flux $\varphi_{B_1} = OA$ is the resultant of all fluxes linking with the secondary and the emf. which it induces therein must therefore wholly be consumed by the secondary resistance. Consequently OP is simultaneously the emf. consumed by the secondary resistance and the emf. induced in the secondary by φ_{B_1}, so that

$$OP = ri_s = \frac{n_s \omega \varphi_{B_1}}{10^8 \sqrt{2}} \qquad (3)$$

In addition OP must be 90 deg. behind OA. Drawing AA_1 parallel to OP, it follows that $\angle A_1AO = 90$ deg.

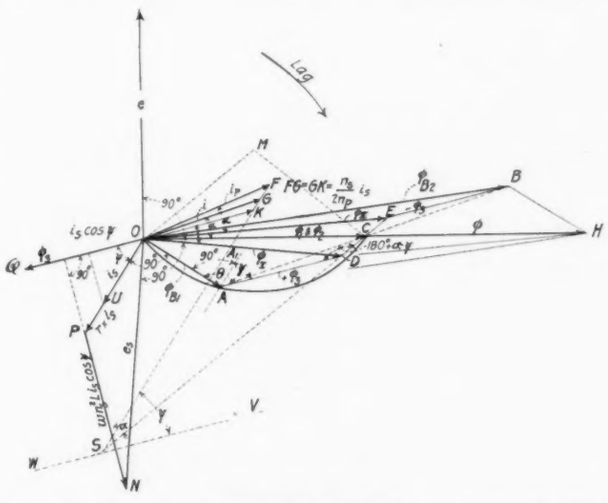


FIG. 8—VECTOR RELATIONS FOR SPLIT-PHASE MAGNET WITH OPEN AND SHORT-CIRCUITED SECONDARY

and since DA is parallel to OQ, $\angle A_1AD = \angle QOP = \psi$, so that

$$\angle OAD = 90 \text{ deg.} + \psi \qquad (4)$$

Drawing through S the line VW parallel to OQ and therefore also to DA, we easily find

$$\angle ADC = \angle WSD \; 180 \text{ deg.} + \alpha - \psi \qquad (5)$$

On account of the similarity of the triangle of exciting currents OGK with the triangle of the corresponding fluxes OCD, we have

$$\frac{i}{\varphi_1} = \frac{GK}{CD} \text{ and since } \varphi_1 = \frac{\varphi}{2}, \quad \frac{2i}{\varphi} = \frac{GK}{CD}$$

Substituting therein for φ from 1 and for GK from 2, we obtain

$$CD = \frac{n_s i_s e \; 10^8 \sqrt{2}}{4 n_p^2 \omega l} \qquad (6)$$

We further have

$$DA = \varphi_s = L n_s i_s \cos \psi \; 10^8 \sqrt{2} \qquad (7)$$

For a given impressed emf., i and α are constants, and assuming in addition for the present L and ψ constant, we see from 7, 6, and 5, that in triangle ADC the sides DA and CD are always proportional with i_s while the angle ADC is constant. However, therefore, i_s may change with a change of the secondary resistance, the various triangles ACD corresponding to various secondary resistances are all similar, so that $\angle CAD$ is constant. But when ψ is constant, also $\angle OAD$ as expressed by 4 is constant, so that $\angle OAC = \angle OAD - \angle CAD =$ constant. Denoting $\angle OAC$ by θ the point A is evidently the apex of a triangle of which the base $OC = \frac{\varphi}{2}$ and the angle θ are constants. The locus of A is consequently a circle of which the center M is found by drawing OM and MC in such a manner that $\angle MOC = \angle MCO = \theta - 90$ deg. Drawing in Fig. 8 the locus circle of the point A, all possible effects from open to short-circuited secondary can be obtained by varying the position of A on the locus circle. With open secondary the point A coincides with C. Closing the secondary and gradually reducing the resistance, the point A moves towards O. With A occupying the position of Fig. 8, the flux in core 2 will be φ_{II} at A_2 and φ_{B_2} at B_2, showing that as we move along the axis of the core 2 (Fig. 7) from A_2 to B_2 the flux gradually changes in phase and magnitude from φ_{II} to φ_{B_2}. Similarly in core 1, the flux at pole A_1 will be φ_I, gradually changing in other cross-sections, until at B_1 it has the phase and magnitude of φ_{B_1}. The closing of the secondary causes a demagnetization in core 1, which at A_1 is slight and is measured by the vector CD, but which at B_1 is measured by the vector CA and is comparatively large. An increase in flux takes place in core 2, measured by the small vector $CE = CD$ at A_2 and by the large vector $CB = CA$ at B_2. Since the decrease of flux in core 1 is equal to the increase of flux in core 2, the total flux at each cross-section of the actual core (not considering leakage through the air) is the resultant flux φ. The effect of the secondary consists therefore in splitting

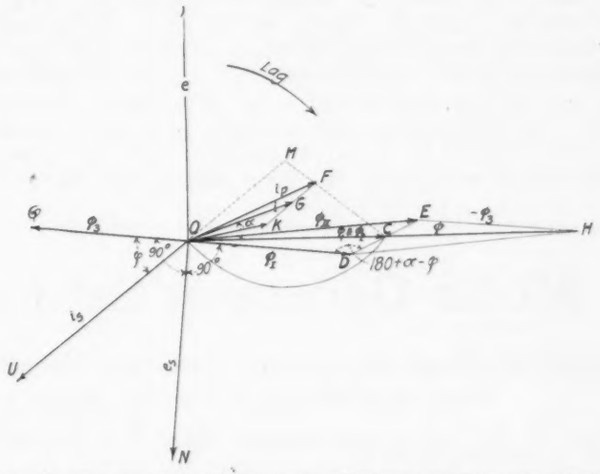


FIG. 9—VECTOR RELATIONS FOR SPLIT-PHASE MAGNET WITH SHORT-CIRCUITED SECONDARY

the flux φ at the poles A_1 and A_2 in the fluxes φ_I and φ_{II}, and at the poles B_1 and B_2 in the fluxes φ_{B_1} and φ_{B_2}.

With short-circuited secondary the point A of Fig. 8 coincides with O. These conditions are shown in Fig. 9. The vector of the secondary current will now coincide in direction with OM, the radius of the locus circle. Since the secondary resistance is zero, the emf., which otherwise is consumed therein, is also zero, so that the resultant φ_{B_1} of all fluxes linking with the secondary, namely, the fluxes φ_I and φ_3 must be zero. Hence φ_I and φ_3 are in the present case equal, but of opposite directions. As compared with Fig. 8, there is clearly very little change in the fluxes at A_1 and A_2. At B_1 and B_2, however, the change is considerable. At B_1, as already stated, the flux φ_{B_1} will be zero, showing that a complete demagnetization takes place at that cross-section of core 1. At B_2, the flux φ_{B_2}, being the resultant of φ_{II} and $-\varphi_3$, will be $OH = \varphi$. With short-circuited secondary, therefore, only a slight amount of phase splitting occurs at A_1 and A_2, but none at B_1 or B_2, and the magnet will behave as a plain single-phase magnet.

As will be clear from the foregoing, the phase splitting at the poles A_1 and A_2 is always slight, and is considerable only at the poles B_1 and B_2, where it is mostly due to the secondary leakage flux φ_3. The flux φ_3 is partly situated in core 1, where it occurs together with the flux φ_I, and partly in core 2, where it exists simultaneously with φ_{II}. Its magnetic reluctance is, therefore, largely dependent on the fluxes φ_I and φ_{II}. Under operative conditions φ_3 is materially smaller than either φ_I and φ_{II}, and since large variations of the secondary resistance cause very little changes in φ_I and φ_{II}, it is not surprising to find from test results that for a constant impressed emf. the coefficient L and the angle ψ are for all practical purposes constants.

In Figs. 8 and 9 the angles α and ψ have been exaggerated for the sake of clearness. As a matter of fact, they are so nearly alike that no appreciable error is made when we assume $\psi = \alpha$, whence by 4 and 5 $\angle OAD = 90$ deg. $+ \alpha$ and $\angle ADC = 180$ deg.

In a second section of this article the holding pull and starting split-phase magnets will be taken up.

Motor-Generator Set for Operating Rolling Mills

An Analysis of the Conditions Under Which a Flywheel Motor-Generator May Be Used in Steel Mill Work and a Graphical Method of Finding the Required Motor Torque for Any Set Together with Other Characteristics

BY WILLIAM KNIGHT
Member Engineering Staff Crocker-Wheeler Company

IN an article published in the Sept. 30 issue of ELECTRICAL WORLD the writer discussed the main points to be considered in designing a motor drive for steel rolling mills and offered a practical solution of the mechanical problem of finding the proper size of flywheel to be used in connection with a given motor. It was pointed out that in some cases it is desirable to use a separate motor-generator and flywheel set to generate the energy required by the mill motor rather than use directly the line supply. In what follows here a practical illustration will be given of the problem of finding the proper size of flywheel to be used on the shaft of the motor-generator set when such a set is employed.

In this case it is assumed that a steady demand of 600 amp. must be taken care of for the operation of a number of direct-current motors and for the friction losses of the mill, and that the peak loads for the operation of the mill itself will require a maximum of 2000 amp. more (Fig. 1). The rating of the set will be considered as follows: An alternating-current induction motor of 575 hp., 440 volts, 60-cycle, three-phase, and synchronous speed of 514 r.p.m. A direct-current generator of 300 kw., 250 volts, synchronous speed 514 r.p.m.

In order to be able to use a moderate size of flywheel and, at the same time, to reduce as much as possible the fluctuation of the energy drawn from the line, the slip of the motor must be increased as much as practicable and at the same time provide efficient operation of the set. In Fig. 2, curves of efficiency, speed and power factor of the motor for 2, 8 and 16 per cent slip are shown. The 8 per cent slip seems to be the most desirable value.

Considering the dimensions of the set, for a first trial a 30,000-lb. flywheel will be considered, 100 in. outside diameter, radius of gyration at 3.37 ft., with a mass moment of inertia as follows:

$$MK^2 = (30{,}000 \times 3.37^2) \div 32.16 = 10{,}600$$

The bearing losses and windage will be estimated at 15 kw. The output of generator at rated load will be

$$\frac{300 \text{ kw.} \times 1000}{250 \text{ volts}} = 1200 \text{ amp.}$$

Average amperes $\times$ seconds needed (Fig. 1) for operating direct-current motors and mill = 1140 amp. The calculated losses of generator at 95 per cent normal load = 90 amp. Expressing also the bearing losses and windage in amperes at the generator voltage, the

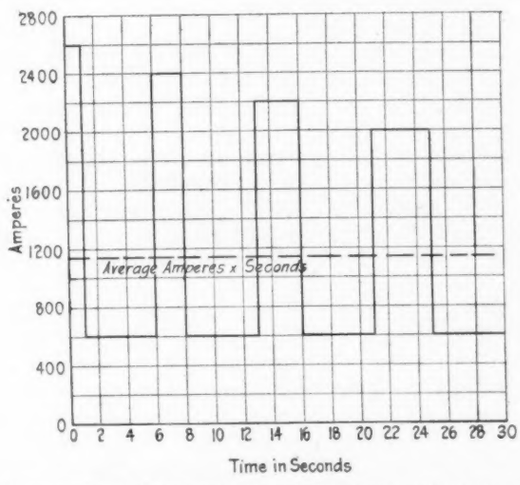


FIG. 1—CURRENT REQUIRED BY A STEEL ROLLING MILL AND A NUMBER OF DIRECT-CURRENT MOTORS

continuous demand of power on the motor and flywheel will be: For operation of direct-current motors and for the friction on mill = 600 amp.; generator losses (average) = 90 amp.; friction and windage = 60 amp. Total amperes, 750.

To this continuous demand for power must be added the demand of power for the operation of the mill at

any instant. The sum of the two must be supplied by the motor and the flywheel. If in Fig. 1 we increase all ordinates by 150 amp. the resulting diagram will give the power to be supplied by the motor and the flywheel during the cycle of operation on the mill. In order to simplify calculations this demand of power will be expressed in foot-pounds torque at 474 r.p.m. (speed of

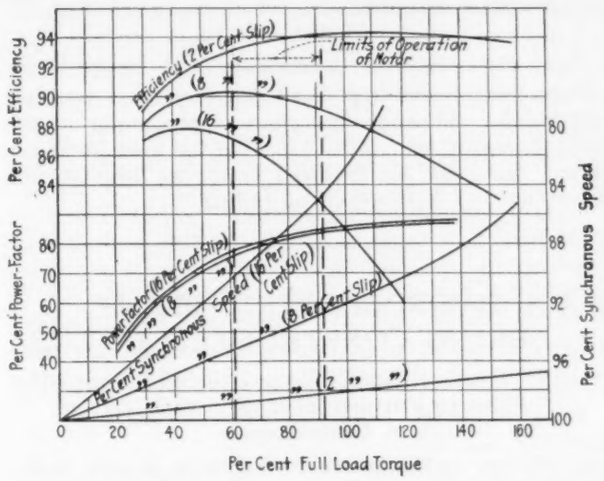

Per Cent Efficiency
Per Cent Power-Factor
Per Cent Synchronous Speed
Limits of Operation of Motor
Efficiency (2 Per Cent Slip)
Power Factor (10 Per Cent Slip)
Per Cent Synchronous Speed (10 Per Cent Slip)
Per Cent Full Load Torque

FIG. 2—CHARACTERISTICS FOR A 575-HP., 440-VOLT, 60-CYCLE INDUCTION MOTOR HAVING SYNCHRONOUS SPEED OF 514 R.P.M.

the motor at normal load) when slip is 8 per cent (Fig. 2). This is not strictly correct, due to the variation of speed of the motor, and if more accurate results are desired the torque should be figured for every corresponding speed in the same way as it was described in the previous article on "Motor Drive for Operating Steel Rolling Mills." For practical purposes, however, the results obtained when the torque at any instant is calculated on the basis of 474 r.p.m. will be sufficiently accurate.

$$\text{Foot-pounds torque} = \frac{\text{amperes} \times 250 \text{ volts}}{1000} \times 1.34 \times \frac{5252}{474 \text{ r.p.m.}} = 3.71 \times \text{amperes.}$$

Multiplying the ordinates of Fig. 1 (all ordinates

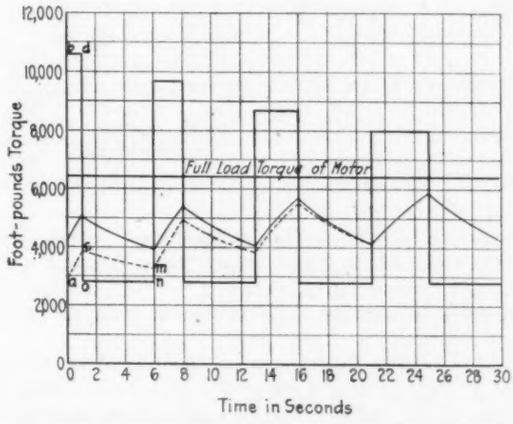


FIG. 3—MOTOR TORQUE AND ENERGY GIVEN UP BY FLY-WHEEL DURING OPERATION OF ROLLING MILL

previously increased by 150 amp.) by 3.71 we will have the energy required at any instant expressed in foot-pounds. (Fig. 3). The torque at any instant during the process of rolling is given by:

$$T_3 = \frac{T_1 - T_3}{e^{\frac{p^2}{MK^2V_s}}} + T_3 \qquad (1)$$

Where p is the ratio of motor torque to corresponding slip, assumed to be constant. In this case torque at normal load equals $(5252 \times 575) \div 474 = 6360$ ft.-lb. slip $= 0.08$, and $p = 79{,}500$. V_s = synchronous speed at 1 ft. radius $= (2\pi \times 474) \div 60 = 49.7$ ft. per second. $MK^2 = 10{,}600$ and e = base of Naperian log $= 2.718$.

Substituting in (1) we have:

$$T_3 = \frac{T_1 - T_3}{1.16^t} + T_3$$

from which, $T_2 - T_3 = \frac{T_1 - T_3}{1.16^t}$ (2)

During the accelerating period $(T_1 - T_3)$ represents the motor torque at the beginning for accelerating the flywheel, and $(T_2 - T_3)$ is the motor torque after t sec-

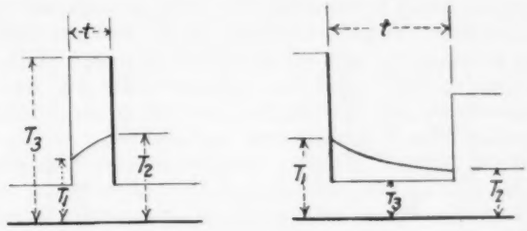


FIG. 4—MOTOR TORQUES DURING DECELERATING AND ACCELERATING PERIODS

onds, at the end of the accelerating period. During the retardation period, multiplying both members of equation (2) by (-1) we obtain $(T_3 - T_1)$ in the second member, which will represent the energy given up by the flywheel at the beginning of the retardation, and $(T_3 - T_2)$ in the first member, which will represent the energy given up by the flywheel after t seconds at the end of the retardation period. In both cases $(T_2 - T_3)$ varies directly as $(T_1 - T_3)$, and for any assumed value of $(T_1 - T_3)$ we can find the corresponding values of $(T_2 - T_3)$ at the end of any time t.

If the exponential equation (2) is plotted with torque in foot-pounds as ordinates against time in seconds as abscissas, starting at zero time with any convenient value of $(T_1 - T_3)$, any two consecutive ordinates at the beginning and at the end of a time t will represent respectively the value of $(T_1 - T_3)$ and of $(T_2 - T_3)$. If one of the two is known and it is desired to know the

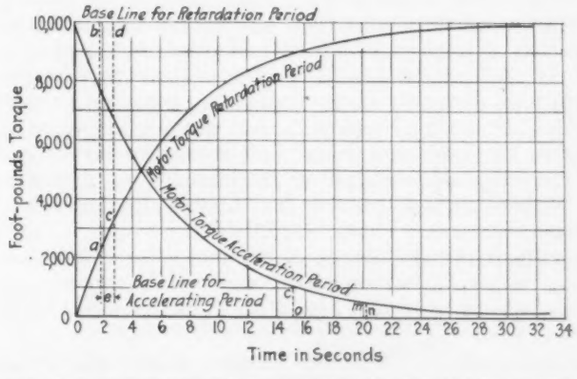


FIG. 5—CURVES FOR DETERMINING MOTOR TORQUE DURING OPERATION OF STEEL ROLLING MILL

other, all that is required is to measure with a pair of dividers the ordinate of the curve having the known value, and measure from that point a distance on the axis of the t equal to the given time. The ordinate of the curve corresponding to that time will represent the value of the unknown quantity, and the ordinates of the portion of the curve comprised between the be-

ginning and the end of time t will represent the intermediate values of that unknown.

For instance, in the case under consideration, suppose $(T_1 - T_2) = 10{,}000$ ft.-lb. Any other value of $(T_1 - T_2)$ could be taken, provided that it had been not less than the maximum value of the peak loads above the steady load of 2800 ft.-lb. shown in Fig. 3 (which in the case considered is 7800 ft.-lb.). When the values of $(T_2 - T_3)$ in formula 2 are plotted for corresponding values of t (using the same scale for torque and time as used in Fig. 3), and taking as axis of the t the lines at the bottom and at the top of Fig. 5, we will have two curves of which the ordinates (measured from the corresponding base line) will give the motor torque at the beginning and at the end of any time.

With a pair of dividers measure *ab* on Fig. 3, and find on diagram 5 the ordinate of the retardation curve equal to *ab*. From point *a* on Fig. 5, measure the distance *e* equal to one second and find *cd*. With the dividers transfer on Fig. 3 the ordinate *cd*, and the point *c* thus located will give us the motor torque at the end of the first peak load on the mill.

With a pair of dividers measure *co* on Fig. 3, and find on Fig. 5 the ordinate of the acceleration curve equal to *co*. From *c* measure on the right a distance equal to five seconds and locate the ordinate *mn*. With the dividers transfer on Fig. 3 the ordinate *mn* and the point *m* thus located will give us the motor torque at the end of the first interval between two peak loads on the mill.

In the same way all other points of the motor torque curve on Fig. 3 can be located. If at the end of the first cycle of operations it is found that the motor torque is not the same as at the start, go through the same process again, starting this time with a torque at the beginning of the second cycle equal to the torque at the end of the first cycle, until the same motor torque is found at the start and at the end of the cycle of operations of the mill.

This graphical method eliminates entirely the calculation of T_2 (formula 1), and gives exactly the same values that would be obtained if all points were found by solving formula 1. Another advantage of this method is that a set of curves like those shown in Fig. 5 can be laid out for different values of $e^{\frac{p}{MK^2V_s}} = A$ in formula 1, and for a given maximum value of $(T_1 - T_2)$, and can be used very conveniently for picking up the proper value of A that will insure a satisfactory operation of a given motor. Having found A, and solving for MK^2, it will be a simple matter to find the dimensions of the flywheel having that mass moment of inertia. If a set of curves is laid out for values of A equal to 1.2, 1.4, 1.6, 1.8 and 2.00, these five curves will cover a very wide range of combination of flywheels and motors, and will allow the interpolation of intermediate values.

Having found the torque of the motor, of the motor-generator set, at any instant during the process of rolling, we can draw in Fig. 3 also the full load torque of the motor $\frac{575 \times 5252}{514(1 - 0.08)} = 6360$ ft.-lb., and it is then observed that the motor will operate between 61 per cent and 92 per cent of the full load torque. Setting on Fig. 2 these two limits between which the motor operates, the speed, the efficiency and the power factor is obtained at any instant.

Motor output in kilowatts = (volts $\times$ amperes $\times \sqrt{3}) \div 1000$. In case of a two-phase motor instead of $\sqrt{3}$ use 2, and in case of a monophase motor or a direct-current motor use 1.

$$\text{Output in kilowatt} = \frac{HP}{1.34} = \frac{\text{ft.-lb.} \times \text{r.p.m.}}{5252 \times 1.34}$$

$$\text{Ampere output of motor} = \frac{\text{ft.-lb.} \times \text{r.p.m.} \times 1000}{\text{volts} \times 5252 \times \sqrt{3} \times 1.34} = \frac{0.082 \times \text{ft.-lb.} \times \text{r.p.m.}}{\text{volts}}$$

$$\text{Amperes input of motor} = \frac{0.082 \times \text{ft.-lb.} \times \text{r.p.m.}}{\text{volts} \times \%\ \text{efficiency} \times \%\ \text{power factor}}$$

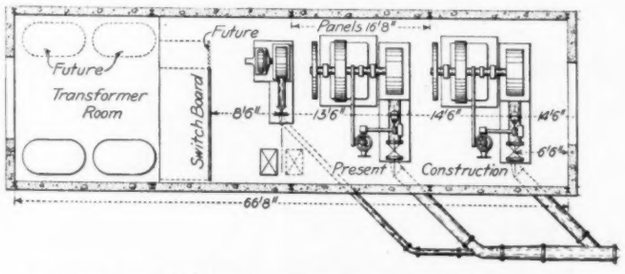
From Fig. 2 and Fig. 3 all the necessary data are available for obtaining the input of the motor of the motor-generator set. This will give the amount of the current that will be required from the line at any instant during the process of rolling.

SMALL HYDROELECTRIC PLANT BEING CONSTRUCTED IN CUBA

A 600-Ft. Head on Guaso River Utilized for 2000-Hp. Plant to Furnish Energy to the City of Guantanamo

A 2000-hp. hydroelectric development is now under construction on the Guaso River in Cuba which makes use of an available 600-ft. head. The Guaso River emerges from a mountain through the mouth of the cave, at which point a concrete dam and intake have been built. The minimum flow was estimated at 30 sec.-ft. during the dry season.

Water is delivered to two Allis-Chalmers 560-hp. impulse wheels and a 60-hp. exciter. These are direct-connected to 470-kva., 2300-volt, three-phase, 60-cycle Westinghouse alternators. Two 500-kw. step-up transformers of the oil-insulated, self-cooling type raise the voltage from 2300 to 23,000 for transmission. The power-house plans provide for the future installation of two more units. The switchboards were furnished by the General Electric Company.



LAYOUT OF 2000-HP. HYDROELECTRIC STATION IN CUBA

Current will be transmitted to the city of Guantanamo and there reduced to 2200 volts. The present power house of the former Guantanamo Electric Company will be used as a substation and its steam plant kept as a reserve.

The value of the location was discovered in 1900 by Eduardo J. Chibas and Arthur S. Hobby when they explored the upper part of the Guaso River during the first American intervention in Cuba. The concessions were granted soon after that and the new Guantanamo Electric Company was organized. The first plans and estimates were made by Mr. Chibas and approved by the government. Cary T. Hutchinson and C. F. Cook then made a thorough investigation of the project and presented their final report in June, 1915.

The work of construction is being executed by the Montreal Engineering Company, of which Carl G. Giles is president and A. E. French engineer in charge.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Cost of Maintaining Four Stokers and Furnaces for Six Years

The data in the accompanying table show what it has cost a Middle West central station exclusive of labor charges to maintain four 10-ft. by 10-ft. chain-grate stokers and their furnaces during the six years they have been in service. It will be noted that the total expense for material has been $2,735.75 or an average of $114.99 per stoker per year. Of this amount $2,354.87 has been spent for tile and fireclay, while $400.88 has been spent for stoker parts, and steel and iron parts of arches and feed gates. The cost per stoker per year for tile and fireclay was $97.29, and the cost per stoker per year for all castings and steel parts was $16.70. In other words, the cost of the tile and fireclay represented 85 per cent of the total material maintenance cost.

COST OF STOKER AND FURNACE REPAIRS FOR SIX YEARS

	Cost of Repairs For Stoker Parts and Iron Parts of Arch and Feed Gate	For Tile and Fireclay	Total
1910	$60.00	.....	$60.00
1911	14.00	$142.25	156.25
1912	61.12	823.17	884.29
1913	40.50	67.50	101.00
1914	3.00	217.00	220.00
1915	33.25	190.25	223.50
1916	189.01	894.70	1,083.71
	$400.88	$2,334.87	$2,735.75
Total per stoker per year	$16.70	$97.29	$114.99

A more detailed analysis of the cost of maintaining metal parts shows that the cost of replacing operating parts of the four stokers was but $8.77 per stoker per year, which is a very small percentage of $1,800 the present cost of such a unit without firebrick. Further study of data concerning the cost of the tile also shows that in 1912, when the maintenance cost was high, one complete 9.5-ft. by 6.5-ft. arch, and fifty large 4-in. by 12-in. by 24-in. bridge wall tile were purchased at a total cost of $498.22, which helped appreciably to increase the total for the year.

W. M. Duncan, vice-president of the Illinois Stoker Company, which supplied these units, in commenting on the data said that since the maintenance cost on the stokers has been so low—$8.77 per stoker per year operating companies should not consider it a hardship if the concerns manufacturing such apparatus required the purchaser to keep repair parts in stock.

Methods of Handling Battery Maintenance Charges for a Large System

In outlining the handling of storage-battery maintenance funds on the Boston Edison Company's system at a recent hearing before the Massachusetts Gas and Electric Light Commission, L. L. Elden stated that the company operates about fifteen storage batteries representing an investment in the vicinity of $800,000, and that during the last year maintenance requirements amounted to about $30,000. In the purchase of a battery it is customary for the manufacturer to give the company a seven-year guarantee, during which the manufacturer keeps the battery in proper physical condition and maintains its stated capacity. During the guarantee period the manufacturer replaces any defective plates or boxes that are clearly due to manufacturing defects. If the company damages a cell in handling, the expense of repairs is assumed by it. At the end of the guarantee period an amount of money is set aside for each battery, depending upon its age and upon what has already been expended upon it.

The Edison company estimates what the probable life of the battery plate is expected to be, with the cost of renewing the plates, and according to such figures a sum of money representing the estimated future repair charge is pro-rated into a monthly charge credited to the use of the battery. Unlike many other pieces of apparatus, a battery may in some unusual occurrence go to pieces in a day, and the amount of depreciation or wear and tear upon the plates is not readily ascertainable at any particular period; hence it is deemed best by the company to pro-rate the renewal charge on these plates over a fixed period rather than to have an abnormal and unequal distribution of expenses due to the company's having to spend say $2,500 on one battery in one month for a complete renewal. The batteries are of various ages and the prospective repair account cannot be taken care of at any one time until the condition of a battery permits it. Mr. Elden said that the number of kilowatt-hours delivered by a battery in a year affords no criterion of the severity of use made of it, since excessive discharges due to accidents, short-circuits or operating conditions may depreciate the plates far more than liberal use within the proper range of discharge. In a single year there may be twenty occasions when battery discharges will be utilized temporarily to overcome adverse operating conditions and maintain the normal standard of service.

Objections to Economizers and Factors of Boiler Furnace Operation

In the discussion that took place at the steam engineering session of the recent New York A. S. M. E. meeting, R. J. S. Pigott, mechanical engineer Remington Arms and Ammunitions Company, Bridgeport, Conn., pointed out that the best operating rate for boilers depends on the operating efficiency and load conditions. He also mentioned that heat absorbed by feedwater heaters was from 10.5 to 11.5 per cent of the heat in the steam. Water should leave the heater at 210 deg. which with a flue temperature of about 500 deg. leaves only about 300 deg. for an economizer to work on and under these conditions he claimed that it does not pay. The point was brought out, however, that if steel tubes were used in economizers, the lower rate of heat transfer in the cast-iron economizer would be overcome and the range of economizer usefulness increased. He maintained that it would pay to force turbines above rating if the generators will allow this condition. He further stated that the coal rate can be predicted within 2 or 3 per cent by the method explained in his paper entitled "Graphic Methods of Analysis in the Design and Operation of Steam Power Plants." In regard to auxiliaries he claimed that the best plan is to provide some way to use steam at low loads, and at

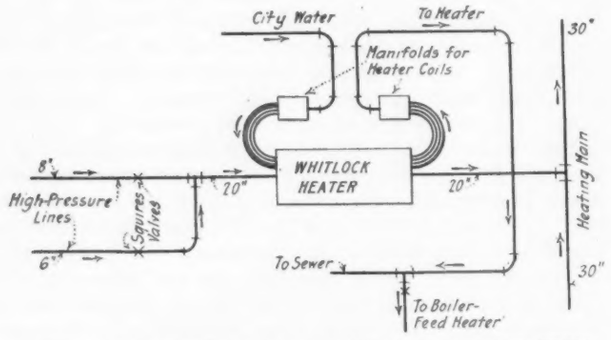
high loads some way to supply the deficiency. Heat balance valves have been successfully used to take care of this condition. It was also pointed out that efficiency of boilers depends on how well the gases are mixed and burned before being allowed to strike the tubes. The shorter the flame the nearer the coal can be brought to the boiler, the more efficient the boiler will be and the larger per cent of heat transferred. The more complete the mixture of gas and air the shorter the flame. The underfeed stoker seems to assist in this action by permitting a complete mixture and a small combustion chamber. It was declared that many are fooled by CO_2 being high since high CO_2 might be caused by too little air. There must be a certain excess of air, 13 per cent of CO_2 being about the best value for average operating conditions. That brick work should not suffer due to high temperature under proper conditions was shown by experiences related by a number of speakers, the deterioration of brick work at the fire level being largely due to erosion that can be prevented by proper combination of brick, furnace construction and grade of coal.

Extracting Superheat from Steam Used for Heating

Experiments have been conducted recently by the Northwestern Electric Company to remove the superheat from steam delivered to its heating system since the high temperature tends to ruin the wood casings around the low-pressure pipes. This is necessary because steam has to be bled from the high-pressure line where the superheat is 150 deg. when the exhaust from the turbines is insufficient for heating purposes. Practically no superheat has to be contended with, however, when the turbines supply all of the heating steam.

Since superheated steam was required for the turbines the most direct way of eliminating the high temperature—at the source—could not be employed. Accordingly attempts were made to reduce the superheat in the heating line by spraying water into the low-pressure mains. This method did not prove very satisfactory, however, so that it was decided to try a Whitlock heater in the line.

The heater consists of six spiral copper pipes with a total of 60 sq. ft. of heating surface. Two of the pipes or tubes have an inside diameter of 1.5 in. and are made



PIPING CONNECTIONS FOR REMOVING SUPERHEAT FROM HEATING STEAM

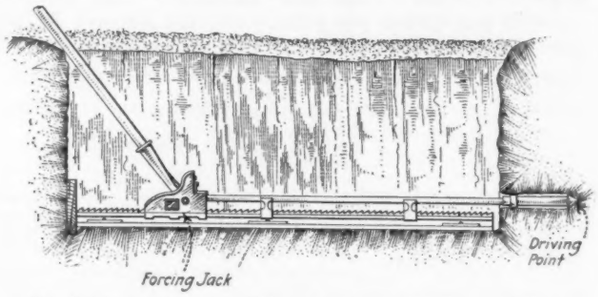
of No. 16 gage copper. The other four tubes have an inside diameter of 1.25 in. and are made of No. 17 gage copper. The inlet and outlet ends of the coils are connected with manifolds and contain regulating valves.

Connections were made so that water could be taken from the city supply at 60 deg., circulated through any number of the heater coils and discharged into an open boiler-feed heater or diverted into the sewer. With the heater thus connected and installed in the high-pressure bleeder line a fifty-four-minute test was conducted during which 45,000 lb. of steam passed through the heater and was reduced in temperature from 525 deg. to 270 deg. The condensation in the steam line due to the heater amounted to 1520 lb., or 33.8 lb. per 1000 lb. of steam reduced in temperature. These results were obtained with water circulating through only two of the six heater coils.

Installing Iron Ducts Without Digging Ditches

BY C. A. DALRYMPLE

Considerable expense has been saved by a large Eastern electric service company when conduits have to be installed under pavements, sidewalks or railroad tracks



FORCING CONDUIT THROUGH EARTH WITH A PIPE-FORCING JACK

by using a pipe-forcing jack. By employing this apparatus the company has also avoided disturbing lawns and flower beds, removing and replacing patent sidewalks and pavements and obstructing traffic by ditches.

The jack is constructed of malleable iron and steel and consists of a cage, which travels on a rack, being moved by a socket lever and pawls. At the front of the cage is a groove and clamp for holding pipe ranging from 0.75 in. to 4 in. in diameter. The rack has machine-cut teeth, is provided with bolts for bolting to a plank, and carries two guides for holding the pipe in line.

To use the jack it is placed in a ditch as shown herewith, the conduit set in the position, and the front end provided with a pointed steel nose, which will cut its way through the earth. The steel nose is attached by a standard coupling. The pipe is then forced through the earth by common laborers. When the cage reaches the limit of its travel, it is drawn back to its starting point and a new section of pipe placed in position and fastened to the first section. The operation is repeated until the desired length of pipe is installed.

The pipe-forcing jack mentioned is made by the Duff Manufacturing Company, Pittsburgh, Pa.

25-Cycle Versus 60-Cycle Operation

In deciding on whether or not to install 25-cycle or 60-cycle systems or a combination of the two, a consideration that often arises in the minds of many engineers when they are confronted with the necessity of purchasing new equipment, the following observations of William Long, superintendent of power stations, Toledo (Ohio) Railways & Light Company, are of interest.

"Some few years ago the 25-cycle system was developed not because it was considered to be the best frequency for light and power, but because it was the only frequency for which manufacturers could build rotaries that would operate successfully. It was also thought that 25-cycles was the only frequency at which energy

could be transmitted any distance due to peculiar characteristics of the frequency. It has been found, however, that 60-cycle apparatus can be made just as stable as 25-cycle apparatus, and of late years a great many power companies have changed from 25 cycle to 60 cycle. As a matter of fact, of the forty-seven high-voltage systems of note in both this country and Europe, the majority operate at 60 cycles and only five of them use the 25 cycles. The rest use from 30 to 50 cycles. The Au Sable Electric Company's system, which is 245 miles long, uses 60 cycles. Of course, there are big differences in the first cost of the two systems in favor of the 60 cycle, but, leaving out the cost factor entirely, it will be found that damage due to short-circuits are much more severe on the 25-cycle than on the 60-cycle frequency."

Convenient Arrangement of Transformer and Rotary Converter Units

Direct-current service for the medical school and hospital buildings of Washington University at St. Louis is provided from two six-phase Allis-Chalmers rotary converters installed in the basement of the Barnes Hospital. In the arrangement of the transformers and the converters which they serve a convenient scheme has been worked out. A hole was made in the concrete floor of the basement and the transformers were set on the floor of a sub-basement. The transformers are three-phase, 60-cycle units rated at 250 kva. They are of the oil-cooled type and reduce the potential of the energy delivered from 4150 volts to 178-89 volts. One transformer with a 200-kw. six-phase, 60-cycle converter, constitutes a set. The transformers are connected in delta on the primary with 2 per cent and 5 per cent taps; on the secondary they are open-connected with 50 per cent voltage taps.

As shown in Fig. 1, the tops of the transformers project slightly above the main basement floor. Directly in front of them are the starting panels for the rotary converters, which are always started from the 50 per cent secondary transformer taps. This arrangement of transformers and starting panels made the in-between connections easy to install and accessible for repairs. Leads between the panels and the converters are supported on brackets beneath the basement floor. Furthermore, the arrangement places the panels and the converters near each other so that the operator can observe the starting action of the machines.

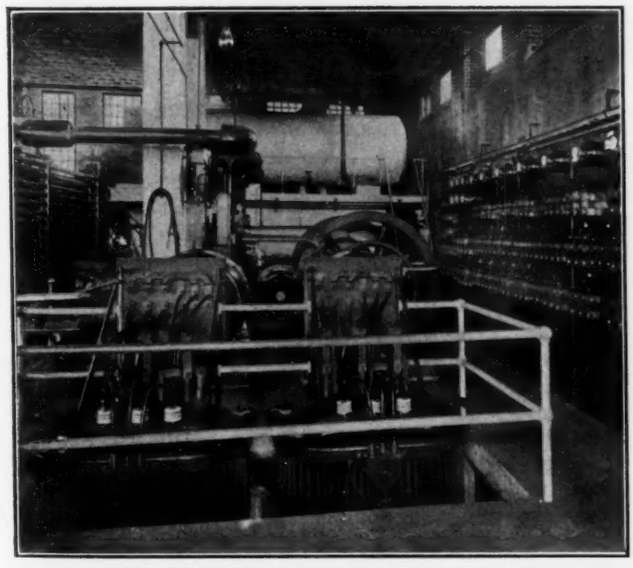


FIG. 1—METHOD OF INSTALLING TRANSFORMERS AND STARTING PANELS NEAR ROTARY CONVERTERS

Alternating current for operating this equipment is supplied from the power plant of Washington University, which contains two 600-kw., 4150-volt, three-phase, 60-cycle, Allis-Chalmers turbines and three 500-hp. Heine boilers equipped with Green chain-grate stokers, the coal and ash being handled by an automatic conveyor made by the Link Belt Company. The transformers were furnished by the Moloney Electric Company of St. Louis and the plant installed by the Light & Development Company of St. Louis under the direction of E. S. Billings.

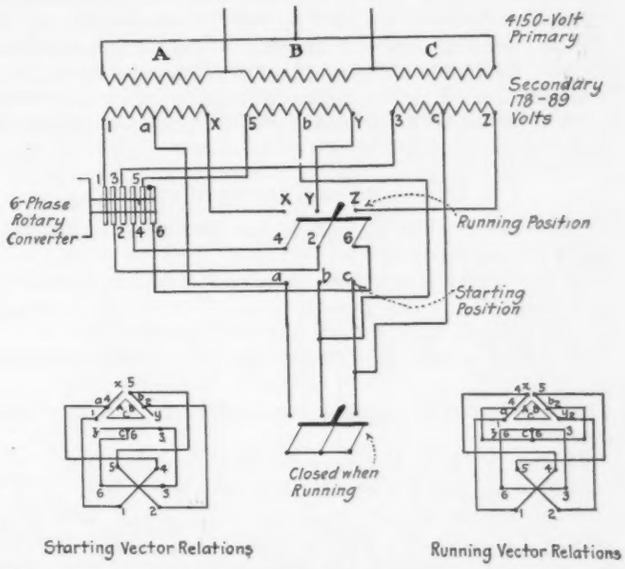


FIG. 2—CONNECTIONS FOR THREE-PHASE TRANSFORMER WITH ROTARY CONVERTERS USING 50 PER CENT TAPS FOR STARTING

How to Determine When Water Is Being Treated Properly

To be certain that water is being properly treated, the following simple tests given by Arthur C. Scott and J. R. Bailey in a recent A. S. M. E. paper can be made, using only standard soap and acid solutions, phenol-phthalein and methyl orange, all of which can be obtained from any dealer in chemicals. For convenience the soap solution should be of such strength that 1 c.c. corresponds to 1 gram of calcium carbonate in 100,000 parts of water, where a 100 c.c. sample of the treated water is taken. The acid should be fiftieth normal ($N/50$).

TEST "H," FOR HARDNESS

A 100-c.c. sample of the water to be tested should be put in the 250-c.c. bottle and soap solution run in 0.2 c.c. at a time, the bottle being shaken vigorously after each addition of the soap solution. Finally, a lather will be produced that will persist for at least five minutes. The volume of soap solution used should then be read in cubic centimeters and recorded as "*H*."

TEST "P," FOR CAUSTICITY

For this test take also a 100-c.c. sample of the water to be tested, add three drops of phenol-phthalein and titrate with $N/50$ acid until the pink color vanishes.

This titration may be carried out in a porcelain evaporating dish, and the acid run in slowly while stirring with a glass rod. The volume of the acid used should be read in cubic centimeters and recorded as *"P."*

TEST "M," FOR ALKALINITY

To the sample of water used in test *"P,"* three drops of methyl orange should be added and the titration continued with the acid, just as left in the burette at the end of the test *"P."* When the orange color produced in the water by the methyl orange changes to a faint red color, read the combined volume of acid used with both phenol-phthalein and methyl orange as indicators and record as *"M."*

DIAGNOSIS OF TREATED WATER

The values of H, P, and M are then used in diagnosing the treated water as follows:

If the water is properly treated 0.5 M should not be less than $H + 1$ nor greater than $H + 3$, and P should not be greater than 0.75 M nor less than 0.5 M.

If 0.5 M equals $H + 3$ too much soda ash has been used.

If 0.5 M equals $H + 1$ too little soda ash has been used.

If P is $> 0.75\ M$ too much lime has been used.

If P is $< 0.5\ M$ too little lime has been used.

Some waters are so high in initial alkali salts that they will not stand a further addition of soda ash without seriously foaming. In such cases barium hydroxide can be used as substitute for soda ash, although its high cost limits its use to emergency cases.

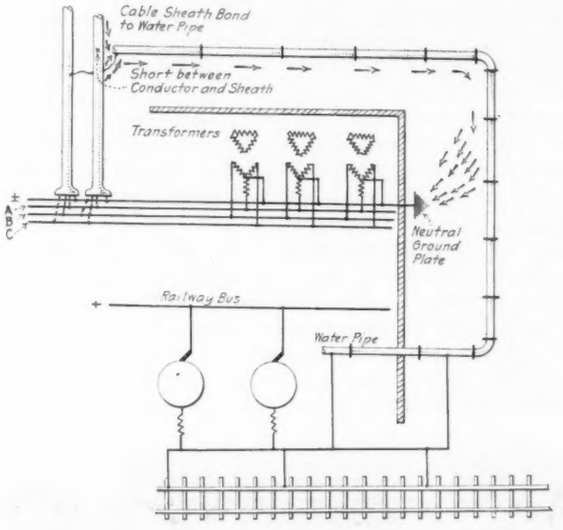
Potential Rise of Station Ground Bus and Its Prevention

In a number of substations of a large central station company rotary converters were installed for supplying the street railway and transformers for the 4000/2300-volt distributing network. The fundamental diagram of the station is shown here, from which it is seen that the negative of the rotaries is earthed to the rails and to the water piping system while the neutral point of the transformers for the distributing network is earthed through a ground plate, but is not connected except through the earth to the railway grounds. The conductors of the 4000/2300-volt system consisted of either single or four-conductor underground lead-covered, paper-insulated cable, the lead sheaths being connected together and grounded to the water pipe or rail in each manhole. The neutral or fourth conductor of each circuit was grounded at the station to the station ground bus as shown, but was kept clear of all grounds elsewhere.

When a short-circuit occurred on one of the distributing circuits it was sometimes found that the ground bus at the station was raised considerably above that of earth, notwithstanding the fact that the neutral of the circuit and of the transformers were connected rigidly to it. This potential rise did not occur in each case of short-circuit, but only sometimes without any apparent reason. On investigating the matter more closely it was found that when a short-circuit took place between phase wires and neutral, or between phase wires, no potential rise occurred at the station, but when the short-circuit occurred between any conductor and cable sheath the ground bus was then raised above that of earth. By referring to the sketch it will be seen that when the short-circuit took place between conductors, the current still flowed along the normal paths, namely, along the phase wires and back along either the neutral or the other phase wire. When the short-circuit occurred between conductor and sheath, however, the current took an abnormal path, namely, along the cable bonds in the manhole from the lead to the water piping system and the railway track, and negative feeders in parallel with it back to the station. At the station, or thereabouts, the current would leave the water pipes, negative feeders, etc., and flow from them across and through the earth to the ground plate to the station ground bus.

It would be natural to consider the impedance of the copper of the station ground bus as contributing to the rise of potential of the ground bus. It does do so, of course, but to such a small degree that it may be neglected, as the reactance, resistance drops and skin effect at even the heavy current rush on short-circuit are quite small. There remains the ground plate to be considered as the possible cause of the phenomena, and a little consideration will show that this is undoubtedly the origin.

The water piping system constitutes a good ground; in fact, the best obtainable. On the other hand, a ground plate, even if bedded with care, may or may not



GROUND CONNECTIONS AND PATH OF RETURN CURRENTS TO RAILWAY STATION

constitute a good ground, and it is on account of the varying resistance of ground plates that one having a resistance of 20 ohms or below is usually considered as being of low resistance, or a "good ground." Now suppose that the ground plate in the present instance has a resistance of 1 ohm—a low value as ground plates generally go—and, further, that on short-circuit the current flowing before the relays have operated the circuit breaker is 800 amp. In taking the path described, that is to say, from the water pipes and negative feeders and rails to the ground plate in the station (as shown), the drop in potential across the ground plate will be, according to Ohm's law, 800 volts. This is a dangerous rise of voltage, and would be a life hazard should anyone make contact with the station ground bus—usually considered safe—and the water pipes during the time elapsing between the short-circuit and the opening of the relays. Were the lead sheaths grounded at the station to either the station ground bus or the water pipe, the voltage rise would be reduced, of course, but many companies do not ground the sheaths of the cables at the station. The above conditions seem to emphasize the advisability of having one common ground in stations rather than two that are connected together by a resistance.

COMMERCIAL AND BUSINESS POLICY

A Department of Plans and Methods for Widening the Application of Electricity and for Extending Electric Service

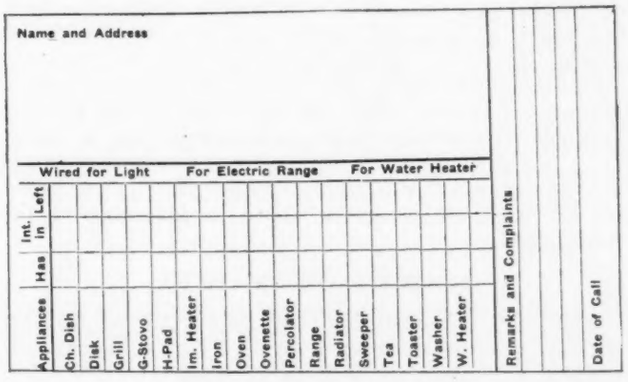
Cost and Results of Appliance and House-Wiring Campaigns in Town of 5000

The Willapa Electric Company recently conducted campaigns for the sale of electrical appliances and for house wiring at Raymond, Wash., one of the cities served by its distributing system, where the maximum residence rates are 9 cents for the first 50 kw. hr., and 7 cents for the next 100 kw. hr.

One salesman, in seventeen working days, disposed of twenty-seven irons, thirty-five grills, sixteen percolators, and two 6-in. stoves.

Total appliances sold in seventeen days	80
Sales varied from none to eight per day, averaging	4.7
Aggregate rating of appliances sold, in watts	40,610
Total number of calls made	497
Average number of calls per day	29.2

These sales were made in a city of about 5,000 inhabitants, in which the total number of accounts was 690 and the total number of meters was 727. It had been thought that the territory was saturated with appliances.



APPLIANCE PROSPECT CARD

Cards like these, on which had been entered the customer's name and address, were carried by the salesman, filled out when the call was made, and provided valuable information on which to base future campaigns. For instance, if the company desires at some future time to conduct a campaign on washing machines, or vacuum cleaners, it will have information directly at hand as to what consumers on its lines are interested in these particular appliances.

The aggregate selling price was $330, and the profit on the appliances $74.83. As the total expense was $87.25, it will be seen that the net cost of the campaign was only $12.42, or about 16 cents for each appliance. The itemized expense was as follows:

Salesman, three weeks at $20	$60.00
Commission, 2 per cent on sales of $330	6.60
Traveling expenses of salesman	8.90
Newspaper advertising, in addition to usual space	3.75
Postal card notices, 600	8.00
Total expense	$87.25

Owing to difficulties in getting a salesman, the advertising preceded the campaign by only three days, when a half-page in the local weekly paper was used. Two subsequent issues contained quarter-page advertisements.

It was decided that the salesman should follow the meter routes on foot, and about thirty postal-card notices were mailed each day to those consumers upon whom the salesman expected to call two days later. He called only at residences and stores in the residence districts. The salesman was provided with a card for each consumer, showing the name and address and a symbol indicating whether or not she was worthy of credit. When returned to the office this card contained a list of the appliances then being used by the consumer and of those in which she was interested.

The samples carried were a 6-lb. iron, a table grill or toaster stove, a utility grill, a 2 or 3-pint percolator, and a 6-in. disk stove, the whole, with case, weighing about 27 lb.

The annual gross earnings from the eighty appliances sold is estimated at about $240, or an average monthly income of 25 cents from each appliance.

THE HOUSE-WIRING CAMPAIGN

Preparatory to making a canvass of the unwired or unconnected residences, etc., upon existing distributing lines, or in near-by territory, arrangements were made with the two local wiring concerns to do all wiring jobs turned over to them at certain fixed prices, at which the company's solicitor could estimate the cost of each job on the ground and take a contract for the work.

Beginning about three weeks after the appliance campaign, one solicitor in four weeks secured the following contracts, viz.:

Contracts for house-wiring:		
Buildings along existing lines	34	
Buildings quite near existing lines	10	
		44
Contracts to connect buildings already wired in whole or in part		16
Total number of consumers added		60

These were secured in a city of about 5000 inhabitants, where the total number of accounts prior to the campaign was 690 and the total number of meters was 727.

As inducements the company offered to carry the wiring account for from three to five months if the credit was approved, and loaned an electric iron with the understanding that it would become the property of the consumer after use of the service for one year. A card record of each building found not using electric service was made.

The total expense, including four weeks' salary of solicitor, the cost of record cards, and the cost of irons distributed, was $219.80, or about $3.66 for each new account. No advertising in addition to the newspaper space regularly occupied was used.

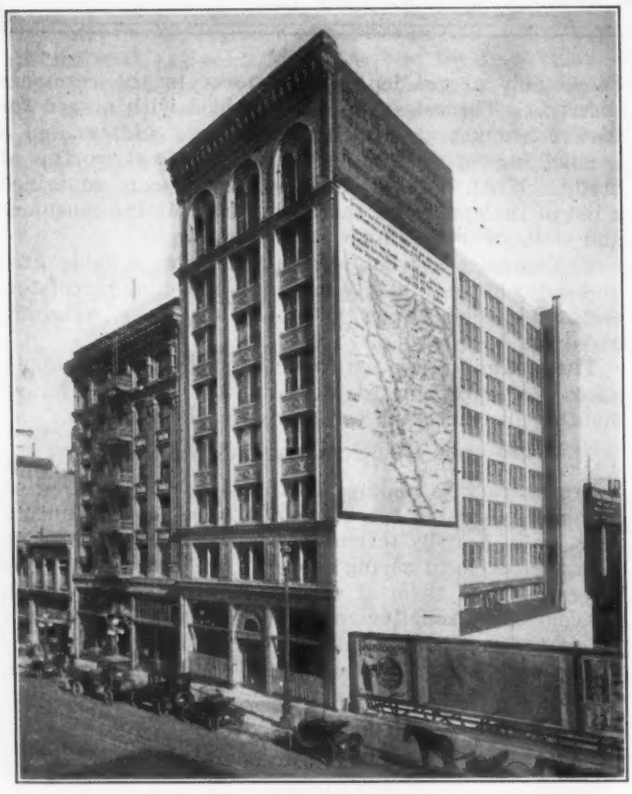
The annual gross earnings from the sixty new consumers is estimated at about $900, or an average monthly income of $1.25 from each consumer.

Advertising Service Continuity with a Huge Wall Map

The Pacific Gas & Electric Company of San Francisco believes in advertising the dependability of "Pacific Service." An effective way of doing this is to impress upon the mind of the consumer the size of the system and the outlay of labor and expense required of the company in order that it may effectively fulfill its obligations. To aid in accomplishing this purpose the company has used a large map about 25 by 50 ft.

in size, which has been painted in bright colors on the wall of the company's new office building, where it can be plainly seen from a busy street crossing.

An inscription over the map explains that the company serves an area of 37,775 square miles, in which is located about two-thirds of the population of California.



THE FIVE-STORY WALL MAP ON THE "PACIFIC SERVICE" BUILDING, SAN FRANCISCO, WITHIN SIGHT OF A BUSY CORNER

The location of each generating plant, transmission line and substation is also shown clearly so that a glance at the map impresses upon one the idea that the company's system draws upon a large number of sources for its 231,917 hp. of electrical energy and 40,000,000,000 gal. of water storage. The lettering is large and clear, and the names of the various plants and cities can be read easily from the street. The idea of using the map originated with John A. Britton, vice-president and general manager of the company.

Electric Trucks Save Money in Garbage Collection

In Barnes, England, the machines now employed for refuse collection are electric vehicles. A saving of 23 per cent has been effected since the conversion from horse-drawn equipment, aside from the distinct gain in service rendered.

The adoption of "electrics" by this municipality was decided upon after a fourteen-day test on a 3-ton machine, during which accurate records were kept of mileage, load, energy, consumption, etc. The trucks used have a capacity of 4.5 cu. yd., and are capable of a maximum speed of about 10 miles per hour. A single charge of battery is sufficient for 40 or 45 miles. Each truck holds twice as much as the type of horse-drawn cart formerly used, and is capable of collecting twenty-eight loads per week as compared with twenty-one loads for the horse-drawn vehicle. It is estimated that eighty-five "electrics" now fulfill the same service that formerly required 275 horses.

SECURING POWER BUSINESS

Viewpoints on Methods and Policies in Force to Secure Industrial Loads—Analysis of Generating Plant Costs

In an analysis of locally generated and purchased energy costs for a Worcester, Mass., paper mill, outlined by W. C. Durant of the New England Power Company, Worcester, Mass., at the recent New England N.E.L.A. convention, it was shown that at least $2,300 a year would be saved by the use of purchased energy. The comparative costs were summarized as follows:

COMPARATIVE COSTS OF ISOLATED PLANT AND CENTRAL-STATION SERVICE

Operation of local plant:		Purchased energy:	
Coal	$50,260	Process coal	$19,330
Labor	13,650	Labor	8,510
Water	3,825	1000-kw. peak at $12.84 and 4,860,000 kw.-hr. at 6.4 mills	43,940
Repairs	7,243	Water	2,300
Supplies	750	Repairs	2,661
*Miscellaneous	2,200	Supplies	260
Fixed charges	11,006	Miscellaneous	500
		Fixed charges	9,131
	$88,934		$86,632

*This item includes extraordinary repairs, losses due to shut-downs, consulting engineering fees, time of superintendent chargeable to power, general office expenses pro-rated to power and other power items which may be charged to other accounts.

It was estimated that additional savings will result from the use of purchased energy in a new building about to be constructed, which will require about 150 kw., and probably 700,000 kw.-hr. a year. If purchased as a separate load the cost of this energy per year will be $2,470 more than when combined with the main load. Exclusive of flywheel shutdowns, due to developing cracks, the Corliss engine was stopped on 163 occasions in the year just closed, with a total loss in time of nearly seventy-six hours. With electric drive for the beaters, troubles now arising from misalignment due to quicksand foundations will be eliminated. The author stated that the prospect of a decision to purchase power based on the analysis as stated above is favorable at the present time.

Possible Saving of 100 HP.

The mill's power station contains six 250-hp. Stirling boilers, Sturtevant forced draft, Taylor mechanical stokers, a 21.25-in. by 40.25-in. by 48-in. Harris-Corliss cross-compound non-condensing engine exhausting into a 625-kva. Westinghouse low-pressure turbine, and a 20-in. by 48-in. Rice & Sargent engine exhausting into paper machinery. Various pumps and auxiliary apparatus were also featured. The machinery in the mill was partly motor-driven, there being twenty-seven motors of 990 hp. combined rating in service, the balance of the drives being mechanical. Test data have shown the engine and shafting friction to be 244 hp. By the use of individual 150-hp. motors for eight beaters, 100 hp. would be saved. Coal costs, roughly, $4.22 per ton.

In the discussion on the analysis presented by Mr. Durant, W. H. Snow, New Bedford, Mass., declared that mill owners can never make more than 3 per cent returns on investments in private plants, while from 10 to 20 per cent can be made in their own business. He therefore maintained that a mill can afford to pay even more for central station service than the cost of producing its own power. Utilities too often hesitate to make power rates low enough to attract large manufacturers, but in reality it is next to impossible to make an unprofitable power rate, considering the effect of such output on station efficiency. The speaker condemned the minimum charge in power sales, urging that central stations take ordinary business risks. Two new mill

contracts of 2800 hp. and 5000 hp. have just been taken by the New Bedford company. R. S. Hale of the Edison Electric Illuminating Company, Boston, Mass., said that while the minimum charge may be dispensed with in power sales, some recognition should be given to the characteristics of the service required. Either a service and a running charge should be combined, or class rates should be applied.

SECURING LARGE POWER BUSINESS

Warren B. Lewis, consulting engineer, Providence, R. I., outlined methods which were successful in introducing central station service into a large hotel plant with varied equipment. After extended investigation entrance was gained on the basis of a year's operating contract, under which the entire responsibility for results was laid upon the central station. A preliminary report recommending the service of the latter was laid upon the table by the owner, but when the lighting company offered to guarantee to operate the plant at a cost not exceeding the average of the past two years, and to rebate the difference between this cost and 110 per cent of the actual cost, if any difference resulted, the contract was signed. Daily supervision by the central station was maintained and the plant was scientifically managed, with outside electric service used for lighting and small power, resulting in a saving during nine months of $4,900. This success was mainly due to the superior technical supervision rendered by the central station, and the installation is now a permanent customer. By intelligent use of the steam-heating system, 50 per cent of the former steam demand was eliminated; condensation losses were cut down and motors were temporarily belted to the ammonia compressors of the hotel refrigerating plant, leaving the engines in readiness for this service if required in winter. The hydraulic elevator equipment, with its steam pump, was left in service, using exhaust steam from the pump for water heating. Regular records of performance were introduced and analyzed with expert engineering skill.

DEMAND AND LOAD FACTOR SYSTEMS FOR LARGE CONSUMERS

Essential differences between the methods of obtaining the customer's demand on eleven systems recently in conference or under investigation were outlined in a paper by R. S. Hale of the Edison Electric Illuminating Company, Boston. It appeared that by combining various features, such as width of each peak, number of peaks, periods of readjustment, etc., almost any result can be attained. With very high load factors the system of measuring the demand does not make much difference, so long as the demand is actually measured. With 100 per cent load factor all demands are the same as the maximum. For ordinary large power customers, the difference between most of the systems amounts to probably about 10 per cent, at the outside, of the average billed demand for the year, but even if the averages all come within 10 per cent, the figures for particular cases may vary considerably more, even up to 50 per cent of the larger or 100 per cent of the smaller.

Since the demand charge in dollars is seldom more than one-third of the bill, or rather, since a change in the demand of a given percentage seldom affects the bill by more than one-third of that percentage, the demand systems will seldom make a difference much in excess of 3 per cent in the net bill to ordinary power customers, although for unusual cases the difference may be large. The effect of taking single demands of such periods as five, fifteen or thirty minutes is that the short or narrow demand gives the highest result. In the case of an ordinary large customer it was reported probable that any single demand much in excess of all others is due to some accident or very unusual circumstance. Most companies that use a single demand arrange that any unusual case shall not have its full effect—that is, the prices used by some companies result in practically no account being taken of any extraordinary demand so long as it does not exceed a high limit, while others let any extraordinary demand affect one month only. With the Boston Edison Company the demand system for small customers only allows the customer to use any peak he chooses once a month without its being measured, provided he gives notice. The effect of using only one peak for any day, month or year, instead of averaging several peaks, is that when using a single peak the first time a high peak is attained it at once seriously affects the billed demand; but the customer can then use the service to that extent as many more times that day, or month, or year as he wishes without further penalty. Mr. Hale held that if all companies measured demand on a half-hour basis it would be well. The hour basis seems a little too long, while anything less than fifteen minutes is very difficult to measure with any degree of accuracy. He also stated that it is better not to penalize a customer severely for a single high demand which does not occur again, but that it is fair to penalize him a little every time he puts on a heavy demand. In the author's opinion free peaks are undesirable where any demand charge is made. It is doubtful if any formal agreement as to demand-measuring practice is practicable, but discussion is likely finally to lead to uniformity on some points.

A Complete High-School Electric Cooking Outfit in an Oklahoma Town of 4000

The Coalgate, Okla., high school burned down last year, and when the new structure was erected this spring the Public Service Company of Oklahoma, which supplies electric service in the town, proposed the installation of a complete electric cooking equipment in the

ELECTRIC-COOKING EQUIPMENT IN THE COALGATE (OKLA.) HIGH SCHOOL

school's domestic science department. The devices installed consist of twenty Hot Point grill stoves, one percolator, and one iron. Coalgate is a community of 4000, and the attendance at the high school is only 150, but the Public Service Company of Oklahoma means to educate all of the town's future household managers in the art and science of electric cooking.

A Central-Station Window That Pictures Local Industry

To the general public the industries of a community —especially those which have a more or less romantic background—are of interest. Everyone is curious to know just what makes the wheels go round in a great mine, a mill, or a factory. A window display that, in

ELECTRICALLY OPERATED MINE PLANT REPRODUCED IN WINDOW DISPLAY OF CRIPPLE CREEK CENTRAL-STATION COMPANY

a simplified manner, shows how local work is done, is sure to attract attention.

How the Arkansas Valley Railway, Light & Power Company capitalized this idea is shown in the accompanying illustration. The miniature mine machinery was actually built and operated in the foreground of the window, and the Cripple Creek scenery effect was obtained with a painted back drop. This display won third prize in a window-dressing contest conducted by H. M. Byllesby & Company and is now being used, one week at a time, by twelve properties of that concern.

The Customer's Viewpoint and the Manager's Opportunity

"One of the manager's greatest opportunities," said F R. Slater, vice-president and general manager of the Texas Power & Light Company, Dallas, Tex., in an address before a meeting of the company's operating staff, "lies in the education of both the company's employees and the public.

"We should keep in mind that what we have to sell is simply the serving of our people, and also try to educate ourselves to see the viewpoint of these people. We are prone, I think, to take upon ourselves the attitude that we are right and the public is wrong.

THE PUBLIC IS RIGHT SO FAR AS ITS KNOWLEDGE GOES

"Instead we must take the attitude that the public is right so far as its knowledge goes, and then while we are educating the public to see our viewpoint, as it seems to us, we will also be educating ourselves to see the public's viewpoint, and if we can bring the two viewpoints together, we have accomplished the greatest thing possible in the matter of service.

"Plant in the customer's mind the seed of the idea of Service First. As in plant life, every seed will not bring forth fruit, so also it is that many of the seeds of Service First fall on seemingly barren ground. But if tenderly cared for with 'courtesy,' nourished with 'politeness,' and trained with 'tact,' these seeds may spring to life unexpectedly.

"You may have a most exacting customer, one who is unreasonable, who is always finding fault. Here is where you can exercise tact. Greet him always with a pleasant smile, a courteous manner, and a friendly word. The day will come when he will break through his shell of discontent and disbelief and will meet you with a smile also, a courteous greeting will be accorded you, and you will have won a friend. This is your opportunity—while you have his ear, his attention, and his interest, acquaint him with the aims of yourself and your company. Tell him of the ideals of the men composing it, the service we are all striving to render to every one, the satisfaction being given other customers.

"SELLING" THE CUSTOMER ON COMPANY SERVICE

"Another way in which we all can grasp our opportunities is to 'commercialize' ourselves. Each of us should constitute himself a salesman. We may not go out and sell our customers an iron or a fan, or some other appliance, but we can "sell" the good will, aims and service that we are trying to render to our customers.

"In the last analysis, every man, to be successful, must be a salesman. When you apply for a job you have to sell yourself to the employer. If you go out to win a sweetheart you have to sell yourself to her. There is not a single action in life which I can trace that is not based, more or less, on salesmanship, that is, on one's ability to sell, or to get the other person to accept one's view or idea."

Industrial Application Suggested by Shaving-Water Heater

The close relation between domestic and industrial electric heating appliances was shown by one circumstance related before the Tampa, Fla., convention of the Southeastern Section, N. E. L. A., in November. A Birmingham, Ala., gentleman was using an immersion water heater for shaving purposes, and the thought occurred to him that if a small heater of this type was a success in the home, it might also be applied to his business.

He took the matter up with the commercial department, and the following installation is the result: Two 10-amp. 220-volt immersion, bayonet-type heaters are inserted in a tank of 120 gal. capacity, in which ingredients were placed and then heated to the desired temperature prior to being run through a trough to a mixer where the mixture was made into a feed for cattle. This equipment averages 500 kw.-hr. per month.

A Separate-Unit System for Electric Cooking Proposed by R. S. Hale

R. S. Hale, who is in charge of the special research department of the Edison Electric Illuminating Company of Boston, has proposed the idea of an electrically equipped kitchen with the cooking units distributed about the room instead of grouped in a single range.

Where several different kinds of food are prepared on one range, he points out, the flavors are blended, but if the electric stewpan, frying pan, boiler, oven, etc., are conveniently located at different points about the room each dish retains its own flavor.

Also, where cabbage or Brussels sprouts are to be prepared, they can be placed in an electric cooker equipped with a long cord and set outside the window, thus avoiding all odor in the house.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

METHODS OF USING THE VACUUM TUBE FOR PLATING

Partly Transparent Mirrors for Photographic Work Made by the Cathode Disintegration Vacuum-Tube Method

OFTENTIMES in the photographic and optical industries it is necessary to split the rays from a light source so as to send one portion of the light in one direction and the remaining portion in one or more other directions. To construct a partly transparent mirror for this purpose to such a fine point that any desired percentage of light from a given source can be accurately transmitted while the remaining light is reflected or absorbed by the glass strikes one at first thought as quite an unusual undertaking. In the first place, a uniform deposit of metal is required and then again the thickness must be determined beforehand to an extraordinary nicety. With electricity, however, the

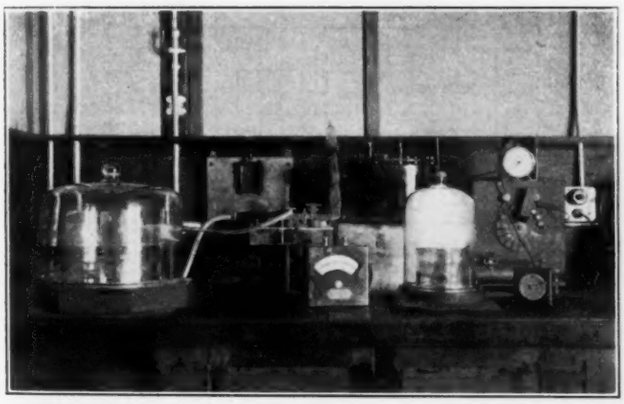


FIG. 1—ASSEMBLED APPARATUS SHOWING LARGE AND SMALL JARS—THE SMALLER JAR IS IN OPERATION

process has become exceedingly simple. Given an energy supply of constant current, a transformer to step up the pressure to 5000 or more volts, an airtight vessel and a vacuum pump, the process reduces itself to a mere tab on the minutes and seconds.

Mirrors of varying transparencies are required in certain photographic experiments which the research laboratory of the Eastman Kodak Company is carrying on, and to make these mirrors the apparatus shown in Fig. 1 has been improvised. The outfit consists essentially of two inverted bell jars, the larger for mirrors 11 in. square and the smaller for mirrors ranging around 4 in. by 5 in. in size, two air pumps, transformer, resistor, ammeter, etc. The cathode is at the bottom of each jar while the anode is at the top as shown. The cathode consists of a thin sheet of metal which is usually of gold or an alloy of platinum and iridium. The glass plate rests on glass pillars and is parallel to and a short distance above the metal sheet, or rather is just on the edge of the Crooke's dark space, as it is called, which becomes visible when the circuit is closed.

The air is first exhausted from the bell jar until the pressure is reduced to a scant millimeter. Since the larger jar is 16 in. in diameter and 11 in. high and the smaller 8 in. in diameter and 12 in. high, the atmospheric pressure on the larger jar mounts up to approximately 5 tons and on the smaller to 2 tons. The current is next turned on and at once a pink glow is

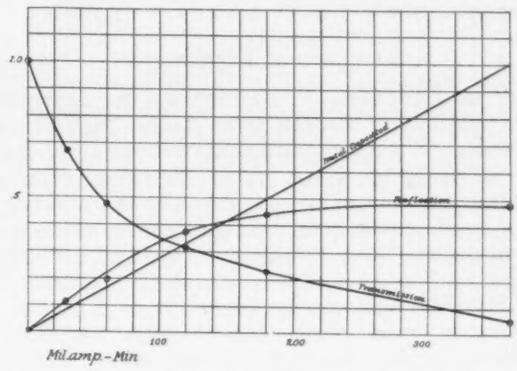


FIG. 2—CURVES TAKEN WITH A PARTLY TRANSPARENT MIRROR OF PLATINUM AND IRIDIUM

noticeable in the space inside the jar. The glass plate on which the metal mirror is to be deposited is placed just at the outer edge of the dark space noted above, because here the metal is most cohesively deposited. Energy of small current value and at a pressure of 156 volts is supplied to the transformer, which steps the pressure up to 5000 volts. The current from the cathode to the anode is measured in milliamperes.

In Fig. 2 are shown several interesting curves based on data obtained with a semi-transparent mirror made in the small jar with a cathode of 70 per cent platinum

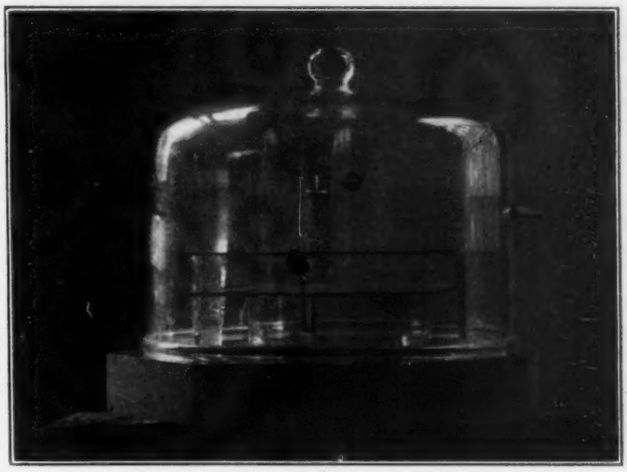


FIG. 3—LARGER JAR SHOWING THIN METALLIC STRIP WHICH IS THE CATHODE AND MIRROR TO BE COATED IMMEDIATELY ABOVE IT

and 30 per cent iridium. The cathode measured 120 mm. by 120 mm. by 0.1 mm. The curves represent reflecting power at 45 deg. incidence, transmission, and amount of metal deposited on unit area plotted against the product of time and current. From these curves

the optical properties obtained from the deposit and the amount of metal deposited by a given quantity of electricity can be ascertained. It will be seen that the amount of metal deposited is proportional to the product of time and current used (just as in Faraday's law).

For each curve eight points were obtained at currents of 20 milliamp., 30 milliamp., and 60 milliamp., and with the time element running from one minute to twelve minutes. It was found that a mirror whose transmission was equal to its reflection required a deposit of 3.4 milligrams per square decimeter.

Platinum is more generally utilized than gold, because with it the coating is harder and from a color standpoint it is more nearly neutral, a quality which is oftentimes a distinct advantage in photographic work. A number of deposits have been made and in all cases remarkably uniform results have been attained.

Lamps and Lighting

Industrial Lighting.—F. H. Taylor.—An abstract of a paper read before the (British) Junior Institution of Engineers on the illumination of industrial premises. Overall efficiency or watts per candle-power given out is too often the only point considered in the selection of lamps instead of the total cost per candle-power-hour, which, of course, takes into account the first cost of the lamp and its life, as well as the cost of current. In a case within the author's experience it paid to use the old-fashioned carbon-filament lamp with its wasteful consumption of 3½ watts per candle-power. This occurred in a factory where not only were more lamps lost by breakage than by ordinary burning out, but the current was supplied by steam-driven generators, the boilers for which were fed entirely on refuse which would otherwise have cost money to cart away. The "general" lighting should be so arranged that a fairly uniform illumination is produced, say, with an allowable variation between maximum and minimum of 20 to 25 per cent, and where individual lighting is additionally provided the value of the former is considered sufficient if of the nature of about 1.5 foot-candles. "General" lighting should be circulated separately from the local lighting, and, where possible, alternate units should form a circuit; a more liberal allowance in the number of circuits or "ways" per distribution board should be adopted, thus insuring a minimum of the lighting units being out of action in the event of a circuit fuse blowing. Motor circuits should be entirely distinct from the lighting supply.—London *Elec. Eng'ing*, Oct. 26, 1916.

Generation, Transmission and Distribution

Research and Future Sources of Energy.—D. Robertson.—His address as chairman of the Western Section of the (British) Institution of Electrical Engineers. The author emphasizes the fundamental importance of scientific research and discusses the best organization of research. He then reviews possible future sources of energy, especially the power of the tides and the power of the sun's radiation. The possibility of getting the energy of disintegration of the atom under control is also mentioned.—London *Electrician*, Nov. 10, 1916.

Pressure Oil Film Lubrication.—H. T. Newbigin.—A long abstract of a paper read before the British Association in which the author reviews the developments of theory and practice of lubrication, with special reference to pressure oil film lubrication and the work in this line done by Osborne Reynolds and by A. G. M. Mitchell.—London *Electrician*, Oct. 6, 1916.

Stokers and Smoke Abatement.—Joseph G. Worker.—An illustrated article on the relation of stokers to smoke abatement, with special reference to the development of the underfeed stoker and forced draft.—*Elec. Journal*, October, 1916.

Installations, Systems and Appliances

Electricity in Agriculture.—Ingvar Jorgensen.—The first part of an illustrated article on "the use of ionized air in agriculture." The author refers to the previous work of Lemström and Oliver Lodge. In their system alternating high-tension current is generated by an induction coil (mercury turbine break, condenser in parallel with the primary). One terminal of the secondary is connected to earth, the other is connected through a series of Lodge rectifiers to the discharge network. The wire system is carried on insulators of the type used in high-tension power transmission, which are mounted on poles. The wires nowhere touch the insulators, but are held taut at some distance from them by means of paraffined cord. The distance of the network above the ground is 15 ft. The author has extended the previous investigations by making quantitative measurements first at Copenhagen at the Government Agricultural Experiment Station and later in England under the Board of Agriculture. The article is to be continued.—London *Elec. Rev.*, Oct. 27, 1916.

Effect of Daylight Saving.—When the (British) summer time act (advancing the clock by one hour for the summer months in order to put working hours as much as possible into daylight hours and save artificial light) was passed at the beginning of the present summer, there was some speculation as to its effect on the output of electricity stations. Some people held the opinion that the loss to electricity undertakings would be serious, and others that there would be no saving in daylight—showing contradictory points of view. Now that the normal time has been resumed the evidence is found to be as follows: In the case of large stations, having a heavy power load, the loss, as would be expected, has been negligible as a percentage of the whole, or it has been masked by the general progress that has taken place otherwise. Thus, at Birmingham, accounts of consumers in residential areas show a reduction of a little more than 16 per cent, compared with the corresponding period last year. But this part of the output is only a small part of the whole, probably less than 10 per cent. On the other hand, where an undertaking is largely dependent on the lighting load, the result of the summer time act has been marked. This is illustrated in Fig. 4, which shows the loss at Winchester. This seems to be about 25 per cent.—London *Electrician*, Nov. 17, 1916.

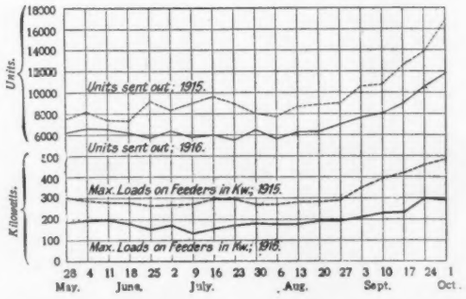


FIG. 4—CURVES SHOWING EFFECT OF THE SUMMER TIME ACT AT WINCHESTER

Magnetic Control as Applied to the Automatic Acceleration of Motors.—A. E. Button.—This installment of the fully illustrated serial on industrial control first states the purpose and advantage of automatic acceleration, then enumerates some of the typical applications embodying remote control. Following this, it explains

the systems of pump-back and dynamic braking, the method of obtaining maximum starting torque, the purpose of the field accelerating relay, and the method of calculating starting resistance values. The installment concludes with a detailed description of the time-limit, the current-limit, and the counter-emf. method of control.—*Gen. Elec. Rev.*, December, 1916.

Units, Measurements and Instruments

Testing Permanent Magnets.—G. B. BETTERIDGE.—An illustrated description of a new apparatus for the commercial testing of permanent magnets. It gives simultaneous values of flux and magnetizing force at any moment, while the magnetizing force is varied in any manner which is desirable, and the indications are read directly without the use of any search coil. It comprises an electromagnet of soft iron and a flux measuring device which consists of a disk driven at a constant speed by a small motor and arranged in an air gap forming part of the magnetic circuit. Carbon brushes run on the spindle and edge of the copper disk, and are connected to a milli-voltmeter, which reads the voltage induced in the disk by virtue of its rotation in the magnetic field, this voltage being, therefore, a measure of the magnetic flux passing in the apparatus. The magnetic circuit is completed by the magnet under

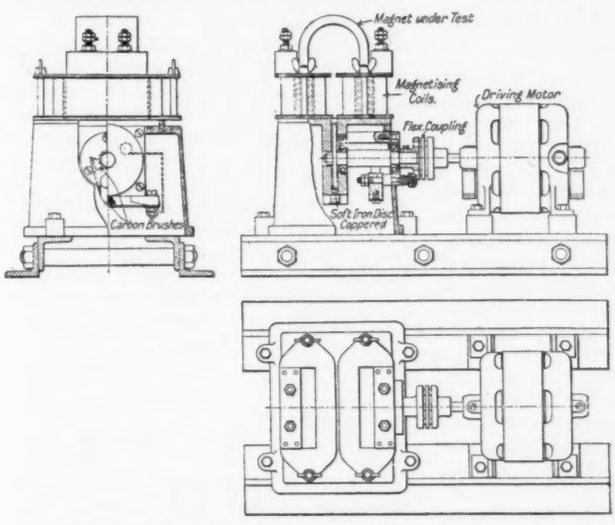


FIG. 5—DETAILS OF APPARATUS FOR SIMULTANEOUSLY TESTING FLUX AND MMF.

test. It is then only necessary to excite the electromagnet with continuous current measured on an ordinary ammeter and observe the voltage induced in the copper disk by the milli-voltmeter. These two readings when multiplied by suitable constants give directly the flux in the magnet and the magnetizing force applied to it, and by varying the exciting current the properties of the magnet can be investigated and its hysteresis loop obtained. Fig. 5 shows the method of construction adopted. The magnet to be tested rests on a pair of angles carried in an aluminum base casting. These angles are separated by non-magnetic distance pieces, and in the space between them runs a soft iron disk having a copper ring attached to its outer edge. The disk is carried on a spindle made of a copper alloy, and carbon brushes run both on this spindle and on the periphery of the disk. The spindle is carried in ball bearings, one in one of the angles and the other in a separate casting bolted thereto. By using ball bearings it is possible to work with small clearances, so that the reluctance of the air gap is negligible in comparison with the magnetomotive force provided by the magnet. The magnetizing force is provided by two coils of wire wound on adjustable brass bobbins, which are attached to the upper face of the angles. These bobbins can be moved to a sufficient extent to permit of the testing of magnets of various sizes. The path of the flux is clear from an examination of the illustration. It will be seen that the revolving disk virtually constitutes a small homopolar dynamo, the directions of flux and rotation being such as to induce an emf. radially outward in the disk. This emf. is communicated by means of the carbon brushes, which run on the spindle and disk to the milli-voltmeter which serves as flux measurer.—London *Electrician*, Nov. 17, 1916.

Air-Core Inductance Coils.—FREDERICK EUGENE PERNOT.—A paper giving valuable formulas and extended tables for the design of air-core inductance coils.—*Univ. of Calif., Publications in Engineering*, Vol. 1, No. 7, pages 117-160, Sept. 30, 1916.

Miscellaneous

Science and Industry.—JAMES SWINBURNE.—A very interesting address delivered before Kings College in London. The speaker emphasized that academic science does not include technology; the chief reason is that academic science is independent of all questions of cost which are fundamental in technology. But he thinks that the best type of science training even for industrial view is the academic. Imitations of engineering and chemical workshops have always the drawback that they are only imitations. In conclusion the speaker emphasized strongly the necessity of a thorough study of economics. "Not only the industry of the country, but the happiness of our people may depend on economics. At present we have practically the whole of the hand-working classes dissatisfied and, therefore, unhappy. The social problem is the most important in the world at present. Its solution must depend on economics. Is it not worth while to study economics with such a purpose, instead of trying all sorts of schemes which are economically pernicious? It may be true that economics has not so far provided any cut-and-dried way out, but until people realize that the science which ought to shed light on this path exists, and that it ought to be studied and developed, drawing the best intellects to it, there is no hope for any end, or even alleviation of the miseries of civilization. I would urge that the first step is for the universities to teach economics, in which I include closely related branches of sociology, with the vigor and insight the subject deserves."—London *Electrician*, Nov. 10, 1916.

France, Italy and Russia.—P. GURIEVITCH.—Statistical data on the exportation of electrical goods from France and Italy. The author does not think that after the war either country will be able to play an important part in the supply to Russia of electrical goods. After the war is over Russia should develop as soon as possible its water-powers, and from the financial point of view it should endeavor to reach a favorable trade balance. "The question, however, with whom Russia shall trade plays only a subordinate rôle of third-class importance, and it should be referred to a back position depending on whether any particular trade is profitable or unprofitable for Russia. The goods of one country may, and should be, exchanged with our own or with the goods of another country, only if such is profitable to the economic progress of Russia. The refusal of any goods only because they are of one or other origin cannot be a healthy principle for a trading policy in time of peace."—From *Elektrichestvo* (Russia), abstracted in London *Elec. Rev.*, Oct. 27, 1916.

British Exports and Imports.—Tables showing the exports and imports of electrical goods from Great Britain and Ireland during September, 1916.—London *Elec. Rev.*, Oct. 27, 1916.

Theories of Magnetism.—SAUL DUSHMAN.—In this concluding article of his serial on the theories of magnetism, the author discusses Weiss's and Parson's magneto theories, also the difficulties inherent in the present theories of magnetism. The last section deals with magneto-strictive effects.—*Gen. Elec. Rev.*, December, 1916.

Electrical Industry in Italy.—The development of the electrical industry in Italy is indicated by the fact that the number of electric horsepowers installed in Italy was 185,000 in 1894, 250,889 in 1900, 897,654 in 1910, and 1,022,960 in 1914. With this development of central stations, the price of energy has gone down. The price of the kilowatt-hour for lighting was 28 cents in 1894 in Milan and is now 4 to 8 cents; for motive power the price has decreased from 5 cents in 1894 to 1 or 1.2 cents now for large contracts, while works which are satisfied with obtaining energy during certain hours only can have it for 0.2 cent. That the financial results of electrical undertakings have been successful is illustrated by a brief sketch of Legure Toscana Electric Company.—*La Lumière Elec.*, Nov. 11, 1916.

Readers' Views and Comments

The Sperry Searchlamp

To the Editor of ELECTRICAL WORLD:

SIR: In the issue of the ELECTRICAL WORLD of Dec. 9, page 1159, a comment by Louis J. Auerbacher was published comparing the Sperry searchlight to the type operating on the Beck system.

In the issue of the ELECTRICAL WORLD of July 25, 1914, the public became acquainted with the new type of searchlight introduced from Germany by Heinrich Beck. In this article (submitted by Mr. Auerbacher, according to his statement), the performance of the Beck light was attributed to the burning of the arc with vapor-cooled electrodes. Previous to this period the Sperry Company had started the development of a new type of searchlight, which resulted in the production of the Sperry high-intensity lamp, giving the high beam intensities and ranges previously unobtainable. There is no trace of vapor-cooled electrodes, as the Sperry idea distinctively goes to the other extreme and operates with superheated electrodes. In fact, all features of design and operation will be found, upon correct comparison, to be fundamentally different.

It may not be generally known, but the facts are that Mr. Sperry was a pioneer in arc lighting in this country, and a large part of the West was enjoying the light given by his system probably before Mr. Beck was born—certainly many years before Mr. Beck was born in the art. Even before the American Institute of Electrical Engineers was organized, Mr. Sperry had the highest and most powerful beacon operating in the world—about 350 ft. above Lake Michigan, the raw light measuring some 40,000 cp.

Early in 1914, while Mr. Sperry was in Germany, he learned from most direct sources that Mr. Beck was not working at all along the lines developed by Mr. Sperry, except for the single point of rotating the electrodes, which was at that time old in the art. Every attempt, even by foreign governments, to employ the Beck lamp has been aggravated and delayed, not only because wholly extraneous material, such as alcohol, has to be furnished, but because only a certain grade of alcohol is found suitable.

It is to be regretted that Mr. Auerbacher should have been so misinformed as to the facts as to make an attempt to confuse the lamp brought by him to America with a purely American product that has resulted in producing beam intensities, ranges and illumination on target, greater than obtained by any other method.

D. M. MAHOOD,
Engineer, Sperry Gyroscope Company.
New York, N. Y.

What Readiness to Serve Really Means

To the Editor of ELECTRICAL WORLD:

SIR: Much has been said in the past about "readiness to serve," and the part it plays in the central station industry, in rate making, etc., but "readiness to serve" often means more, much more, than is implied or realized by the public. Recently a case came up that forcibly reminds one of the meaning of "readiness to serve" in its widest sense. A steel company had started operation, relying solely on one electric furnace for its melting. At the time only a 1-ton furnace was installed, and this was working night and day continuously making castings for agricultural, automobile and railroad industries. About ten heats were run a day, and actually the furnace was turning out about 25,000 lb. of steel during this time. Energy was obtained from the local central station company at 12,000 volts, 60 cycles over underground paper-insulated three-phase cables, of which there were two. Two sets of transformers were installed in the steel company's substation, one set of three single-phase 12,000 to 240 volts for supplying the lighting and power for the compressor, for the sand blast, the crane, the tumblers, etc., and one single-phase 700 kva. transformer for supplying the furnace. This transformer had internal reactance for stabilizing the furnace arc and for protection against undue coil stresses.

About mid-day on one Saturday the single-phase transformer supplying the furnace broke down between primary and secondary, and, in addition to other damage to equipment, ruptured two current transformers in the 12,000-volt bus belonging to the central station company. Within half an hour of the shutdown the central station company had its representatives on the ground to investigate the trouble, and to take steps to help the steel company out of its dilemma, according to its policy of helpfulness and readiness to serve. The transformer had not yet been accepted by the steel company from the contractor, hence neither the steel company nor the central station company were altogether free to act. Telephonic communication with the builder of the transformer elicited the fact that nothing could be done toward replacing the transformer completely or in part earlier than three weeks at the best, which, of course, meant enormous loss to the steel company through lost output, crumbled cores, labor, etc. As the contractor was unable to assist it remained for the central station company to find a way.

The central station company had on hand, ready for an industrial substation in course of erection, six single-phase transformers. As there was no space to spare in the existing substation, which was a corrugated iron affair, a wooden housing was built outside and alongside the original structure, but a little nearer to the furnace. Since the transformers used in this emergency were of ordinary characteristics, a home-made reactance coil was built for insertion between the transformers and the furnace electrode.

The shut-down occurred at about noon on Saturday. The defective transformer was out of its case when the decision was reached that no relief could be expected from the manufacturers before three weeks. At 10 p. m. the same day the central station company placed its engineering skill and complete organization at the disposal of the steel company. Early on Sunday morning the company decided to utilize its existing apparatus for the steel company's needs, and by Monday morning plans were out for the erection of the transformer housing, the transformers were on their way to the steel works, cable was being measured out for laying and the inductance coil was being calculated. By Wednesday evening the furnace was making steel.

This is not an example of any special engineering feat, although the adaption of existing apparatus to a special purpose is interesting. It is, however, a typical instance of readiness to serve in its true sense, and of co-operation of a central station company with a customer to save the latter an enormous financial loss. The good-will of the public is one of the greatest assets of the public utility. Acts like these in any business go a long way toward fostering a feeling of fellowship and friendship that is really permanent.

GILBERT RUTHERFORD.
Evanston, Ill.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

W. E. MITCHELL

W. E. Mitchell, the new president of the Southeastern Section of the N. E. L. A., is the operating manager of the Alabama Power Company at Birmingham, Ala. Mr. Mitchell was graduated from the Massachusetts Institute of Technology with the class of 1903. His first engineering work was done in the testing department and calculating room of the General Electric Company at Schenectady, where he remained two years. In 1905 he went to South America and for five and one-half years he was connected with the design and operation of hydroelectric plants, transmission lines and municipal lighting equipment on the Southern continent, working with the Sao Paulo, Rio de Janeiro and Bahia tramway, light and power companies. Mr. Mitchel returned to the United States in 1911 to take up work on the Pacific Coast with the General Electric Company. After a year in the West he took charge of electrical design and construction for the Alabama Power Company at Birmingham, Ala., and for the past two years has been its operating manager.

Robert L. Noonan has been appointed representative of the Jovian Order in the field. Mr. Noonan is a recent graduate of Missouri State University, Columbia, Mo.

E. A. Turner has resigned as a member of the engineering staff of the Philadelphia Electric Company to become assistant engineer with the Lehigh Navigation Electric Company, Hazleton, Pa.

W. B. Page, who has been superintendent of the Interstate Public Service Company at Columbus, Ind., has been placed in charge of the electric-lighting plant of the Central Indiana Lighting Company at Columbus.

E. E. Yensel, who has been superintendent of the Eastern Pennsylvania Power Company of New Jersey, at Dover, N. J., has been appointed manager of the company, succeeding P. A. Staples, who recently resigned to become vice-president and general manager of the Binghamton (N. Y.) Light Heat & Power Company.

Louis H. Egan has been appointed general manager of the Electric Company of Missouri and the St. Louis County Gas Company at Webster Groves, St. Louis County, Mo., succeeding Charles S. Ruffner, who has become vice-president of the Union Electric Light & Power Company. Mr. Egan was formerly general manager of the Kansas City Electric Light Company, and prior thereto was connected with the Eastern Michigan Edison Company.

F. B. JEWETT

Frank B. Jewett, who has just been appointed chief engineer of the Western Electric Company, succeeding C. E. Scribner, who retires to become consulting engineer for the company, was born in Pasadena, Cal., on Sept. 5, 1879. He was graduated from Throop Polytechnic Institute in 1898, receiving the degree of A. B. in electrical engineering. He entered the University of Chicago the same year, and in 1902 received the degree of Ph.D. there. Dr. Jewett then became instructor of physics and electrical engineering at the Massachusetts Institute of Technology, a position which he held until 1904 when he joined the engineering staff of the American Telephone & Telegraph Company. For eight years he directed the transmission development work of that company and in 1912 he became assistant chief engineer of the Western Electric Company, where he has had charge of engineering development and research work since that time. Dr. Jewett was recently appointed a member of the National Research Council.

OBITUARY

Frederic H. Reed, first vice-president of J. G. White & Company, died in New York Dec. 9. Mr. Reed was born in Stamford, Conn., in 1865. From 1881 to 1883 he worked as a draftsman and in 1884 he became first assistant engineer on the construction of the Tenth Avenue cable railway in New York City. In 1885 Mr. Reed left the cable-railway company to accept the position of chief engineer of the Daft Electric Company, where he remained five years. He designed apparatus for the first commercial electric railways, and it is asserted that he was the first to use the word "trolley" in connection with electric railways. He designed and installed electric railways in Ithaca, N. Y., Camden, N. J., Asbury Park, N. J., and elsewhere. Since 1899 Mr. Reed had been successively secretary, treasurer and first vice-president of J. G. White & Company in New York, and has served as director in many light and railway companies in this country and in Porto Rico and the Philippines, operated by J. G. White & Company.

F. H. REED

George S. Haley, president of the General Engineering & Management Corporation of New York City, and well known as a public-utility executive, died in Roosevelt Hospital, New York City, on Dec. 3, after being struck by a taxicab. Mr. Haley had attended the banquet at the Waldorf-Astoria given to celebrate the flood-lighting of the Statue of Liberty, and the accident occurred while he was leaving the subway station at Columbus Circle. Mr. Haley was born in Manchester, N. H., but was graduated from the University of Iowa. In 1892 he became manager of the City Electric Company at Rutland, Vt., and when the Rutland Railway, Light & Power Company took over the City company in 1908 Mr. Haley was appointed general manager of the organization. His New England position was given up in May, 1912, when he became vice-president and general manager of the Texas Power & Light Company, with headquarters at Dallas. Last June he resigned that post to accept the presidency of the New York company.

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

A New Line of Astatic Electrical Instruments

A complete line of astatic laboratory and portable standard instruments designed and developed by R. D. Hickok for use on alternating-current and direct-current circuits and horizontal edgewise and round patterns of direct

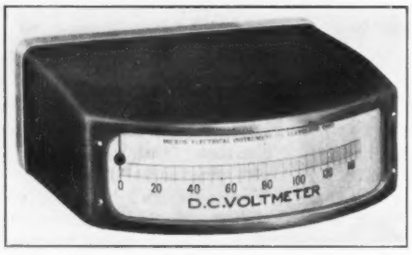


FIG. 1—NEW STATIC DIRECT-CURRENT AND ALTERNATING-CURRENT SWITCHEOARD INSTRUMENT

and alternating-current switchboard, ammeters, voltmeters and wattmeters is now being made by the Hickok Electrical Instrument Company of Cleveland, Ohio. The laboratory and portable standard instruments are of the astatic dynamometer type, and made in ranges up to 750 volts and 100 amp. The astatic feature is obtained by using two complete elements so connected that their polarities are 180 deg. apart. Any field increasing the torque in one element will decrease the torque an equal amount in the other element, and as all the elements are in series, the deflection will not be affected.

The field coils are manually revolvable by a button at the top of the instrument, the location of which is determined by position of the secondary pointer. The deflection pointer which is attached to a moving coil and is normally 90 deg. from the field coils is allowed about 10 deg. movement. It has been found that the accuracy of the reading is not affected more than one-tenth of a division within these limits. Where the finest results are required the pointers can be instantly adjusted to the same deflection. This can be done while making a reading without disturbing the deflection pointer. The arrangement of keeping the field and moving coils in the same relation to each other gives in the wattmeters a uniform spaced scale and for the voltmeters and ammeters a scale which advances uniformly with the square of the current, with a maximum torque with all deflections. The wattmeters are of a high resistance, about 50 ohms per volt in the potential circuit.

Errors due to the rise in temperature in the potential circuits of wattmeters and voltmeters, it is claimed, are practically negligible, the average temperature coefficient in the wattmeters and voltmeters for 150 volts which are approximately 0.00004 per degree Fahrenheit.

The ammeters are built after the same general principles, except that the field coils and moving coils are connected in parallel. The rise in temperature in both circuits is proportional to the resistance and the inductance of the two circuits is likewise proportionate, which gives a correct reading on all commercial frequences, and a temperature coefficient which is less than 0.000002 per degree Fahrenheit.

The "damping" or "dead beat" features in these models are secured by an aluminum vane of light weight, ample clearance being allowed for this vane with a connection to the moving coil so that violent deflections of the moving element will not injure it.

The standard instruments are made in two sizes, the portable standard approximately 6.5 in. by 7.25 in., and the laboratory standard. which is 12 in. by 12 in. by 5 in. The length of the pointer in the portable size is 3.5 in. and in the laboratory size 7 in., with a full scale deflection of 88 deg. in both sizes. These instruments can be standardized with direct current and used with equal facility on alternating current. The astatic feature in connection with the dynamometer type of movement is said to make the instruments equally as accurate on direct current as on alternating current.

The horizontal edgewise instruments are designed for medium and large size switchboard work where a long scale is desired and a minimum amount of room is available. The instruments are made in two models, one for alternating current and one for direct-current use. The direct-current design contains a d'Arsonval movement, which has been standardized and built for high accuracy and rough service. The other type contains a dynamometer type of movement which is said to possess new construction features, which make it very rugged and reliable.

For this instrument the following claims are made: It is correct when used on any frequency from 1 to 133 cycles; on all wave forms; on direct as well as alternating current, and can be calibrated on direct or alternating current. It has high torque and also takes less energy to operate than the iron vane or induction types.

The dynamometer movement for this instrument is made up of two coils, a fixed field coil and a moving coil surrounding the field coil in such a manner that the resultant turning torque between the two coils is uniform throughout a 90 deg. movement of the moving coil which gives a uniform scale in the watt-meter and a uniformly increasing scale in the voltmeters and ammeters. The frame work is cast in one piece of an insulating material containing a semi-circular chamber which contains a light aluminum vane attached to the moving coil making the instrument "dead beat." The construction of this movement is shown in Fig. 2.

The round case designs of switchboard instruments made for direct-current work include voltmeters, ammeters and volt-ammeters. The movement operates upon the d'Arsonval principle, and has a small, light and strong moving coil. The high torque of this movement is secured by the combination of a powerful magnet and the design of moving element.

For milli-voltmeters a departure from the usual practice is claimed in that a high resistance is obtained by an improvement in the shape of the moving coil which results in a maximum number of ampere turns with a given resistance and a correspondingly low temperature coefficient. This design is in contrast with designs of switchboard millivoltmeters for use with shunts which have the internal resistance of the instrument as low as possible. Good torque is obtained by this method, but the temperature coefficient is great and the slightest change in the resistance of the external leads will seriously interfere with the accuracy of the reading. In the Hickok milli-voltmeters the total resistance of the design for use with shunts with 50 milli-volts drop is from 8 to 10 ohms, of which a very small per cent is copper.

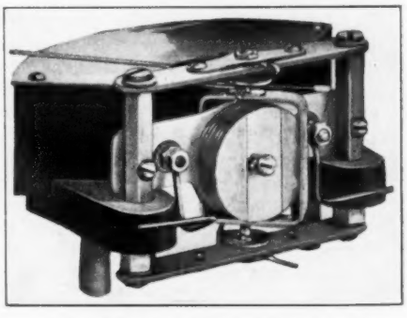


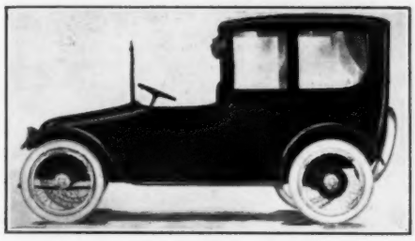
FIG. 2—DYNAMOMETER TYPE MOVEMENT FOR HORIZONTAL EDGEWISE SWITCHBOARD INSTRUMENT

These models are designed for ratings up to 750 volts and 5000 amp. The arrangement of the movement allows the use of a long scale having a radius of 3.5 in. and a length of 5.5 in. A complete line of current and potential transformers is made for use with these instruments when required.

Light Electric Town Car

Not only a sturdy light car. but an elegant one for motor delivery service and the like is now being made by the Milburn Wagon Company of Toledo. Ohio. In regard to this model this company points out that it has more speed than the laws allow—more mileage than can be used in a day; is safe, light and easy on tires; and that it costs less for power than any other car of its type.

The car, which is shown here, seats five passengers and driver—four passengers inside and two on the driver's



INEXPENSIVE ELECTRIC CAR OF ELEGANT APPEARANCE

seat. The wheelbase is 105 in.. and the overall length 146 in. A General Electric motor and controller is used, the controller being a drum type entirely inclosed and mounted on self-lubricating bearings. Either Philadelphia. 40 cells. 11 W.T.X.I. standard or Edison 60-G-6 storage batteries may be employed. The springs are of chrome vanadium steel; the front, semi-elliptic; the rear, cantilever. The spring bolts are provided with self-lubricating bushings. without grease cups. The wheels are the wire type, using tires 33 in. by 4 in. The car has a speed of from 6 to 25 miles per hour and the radius of driving on a single charge is said to be from 60 to 80 miles on lead batteries, and from 70 to 90 miles on Edison batteries. The equipment consists of two headlights, two pillar lights, two interior lights. one taillight. one driver's signal, volt-ammeter, electric horn, speedometer, tools, jack, hydrometer, charging plug and pump.

Light Weight Electric Heater

The heater shown in the accompanying illustration has been developed by the Majestic Electric Development

HEATER WITH PARABOLIC REFLECTOR

Company, 428 O'Farrell Street, San Francisco, Cal. A burnished copper parabolic reflector is provided which, it is claimed, intensifies the radiation of the heat. It is claimed that each heating unit attains a temperature of 2000 deg. Fahr. in from one to two minutes and remains at a constant temperature as long as the current is turned on. The heater is rated for 615 watts, stands 15 in. high and weighs 7 lb.

Individual Control Sockets for Candle Fixtures

Candle fixtures that are provided with individual control in which the symmetry of appearance or the rigidity of construction of the fixture is not destroyed are being made by the Bryant Electric Company of Bridgeport, Conn. In these fixtures the substantially designed operating mechanism is rigidly fastened near the top of the candle. By this arrangement advantage is taken of space within the candle which has heretofore been wasted, and ready access is provided to the binding screws for wiring. Because the mechanism and parts are not crowded together, the danger of short-circuit is practically eliminated. Furthermore, the arrangement of the

FIG. 1—CANDELABRA TURN SOCKET—DETAILS OF CONSTRUCTION MAGNIFIED

mechanism lends itself to practically any design of fixture, as the bobeche may be made as small as might be desired, while the cup may be liberally proportioned without interfering in any way with the perfectly satisfactory operation of the switch.

As will be noted from the illustrations, the chains from the pull sockets, Figs. 1 and 2, hang perpendicularly in the candles and are carried through very small holes in the bobeche and candle cups, leaving only enough chain extending from the bottom of the fixtures to permit of easy location and operation. In the "turn" devices, Fig. 2, two circular superimposed disks are provided. These two disks, in addition to the sockets of Figs. 1 and 2, can be inserted in any fixture by firmly fastening the upper one to the pipe stem with the lower disk securely fastened in the bobeche or candle cup. The rotation of the latter, in either direction, will pull the chain down sufficiently to operate the socket. In this way, the entire operating mechanism is completely hidden from view and the very daintiest candle fixtures can be made up with individual control of lights. It will be noted that the bead chains are provided with a splicing link close to fixture proper which permits fixture manufac-

FIG. 2 — CANDELABRA PULL SOCKET (LEFT); MEDIUM-BASE CANDLE PULL SOCKET (RIGHT)

turer to disconnect the lower exposed portion of chain for special finishing to match balance of the fixture. In the medium base device, the mechanism is firmly supported within a liberally designed molded insulation block of nonbreakable material instead of the old-style porcelain block, while the candelabra base is supported by three heavy brass "legs" which absolutely prevent any side play even when the pull chain is actuated by a sudden jerk. The switch mechanism consists of a thick insulated disk with pall spring and ratchet contact and escapement. Another feature worthy of note to the fixture manufacturer is that these sockets fit inside standard porcelain and fiber candles.

Electric Tea Kettle

The Hotpoint Electric Company of Ontario, Cal., has recently brought out an electric tea kettle with a submerged-type heating element—that is, the element is on the bottom of the tea kettle and entirely surrounded by water when the device is being used. This tea

TEA KETTLE WITH SUBMERGED TYPE HEATING ELEMENT

kettle is made of drawn copper, spun into shape with a spout of white metal. The grip is made of ebonized wood, comfortably shaped for convenient pouring. The lid has no hinge to come

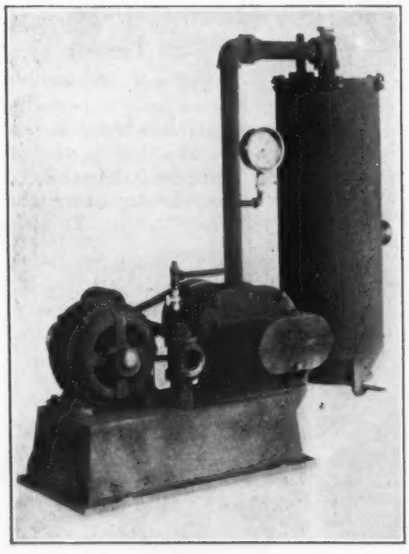
off and locks on securely. The kettle is finished outside in highly-polished nickel to reduce heat radiation to a minimum. The inside of the kettle is coated with block tin. It is provided with fiber feet which prevent scratching and transmission of heat to tables. The tea kettle holds 2.5 pints.

Vacuum Cleaner

Vacuum cleaners for bare floor work that handle a large volume of air and when used on carpets and rugs will automatically create the higher vacuum necessary for thorough cleaning are being introduced to the trade by the Atwood Vacuum Company of Rockford, Ill. This cleaner is said to operate on a vacuum with a maximum of from 5 in. to 12 in. mercury, depending upon the size of machine and surface being cleaned.

The cleaner illustrated is known as a single sweeper machine and is made in four sizes. Slow-speed Westinghouse direct-current or alternating current motors are used with belt drive and automatic adjustment of tension by means of a gravity idler. An automatic unloading valve is also provided which operates at any desired vacuum. When the system is closed this valve removes about one-half the load from the motor, while with general run of cleaners the motor has its maximum load when the system is closed. The cleaner shown is the one most commonly used for residences. It is driven by a 0.5 hp. motor and gives a maximum vacuum of 5 in. mercury. The exhauster operates at 750 r.p.m. and has an air displacement of 50 cu. ft. per minute. Other sizes require 0.75, 1.5 and 2-hp. motors, and maintain a maximum of 7 in., 8 in. and 9 in. of vacuum respectively.

The exhauster is of the two shaft ro-



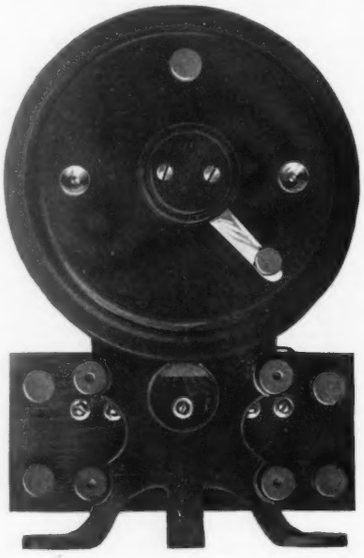
ELECTRICALLY-OPERATED VACUUM CLEANER FOR BARE FLOOR OR CARPET CLEANING

tary type, operating a water seal. Two impellers, shaped like figure 8's, rotate a pair of gears in a case with slight clearance between and all around them. Separation of the dirt is accomplished by means of a bag fastened to the top plate of a tank and extending down around a bag ring at the end of bag rods and then up in the middle, where it is fastened to a chain for shaking. By this means a large screening area is obtained which can be easily and positively cleaned without opening or touching the bag.

The Atwood cleaner is furnished as a stationary plant for installation in the basement and piped, with hose attachments at each floor. Switches are also furnished for each floor, so that the cleaner may be started and stopped from any station. The equipment includes, carpet tool; under-furniture tool; upholstery tool; floor tool; wall or dusting brush; radiator tool; tufting nipple; cleaner handle; and cleaner handle elbow.

Potential Rheostat

Two rheostats combined in one compact unit, one a step rheostat for coarse regulation and the other a slide wire rheostat for fine graduations are shown



TWO RHEOSTATS COMBINED IN ONE COMPACT UNIT

here. These rheostats provide a simple, but efficient, means for obtaining quickly the graded voltage necessary in checking voltmeters, watt-meters, watt-hour-meters, etc. They may be used as a means of control where a storage battery is the source, since they permit the battery to discharge uniformly. Extra taps from the battery are also eliminated by their use. The rheostats furnish voltage values anywhere between zero and the voltage value of the source to which connected. A safety button permits of instantaneous disconnection, in emergency, of the instruments or devices being tested, and this button can only be reset by returning the control to the zero position. Attention is called to the fact that all of the desirable features of a slide wire rheostat are retained, thus assuring smooth and uniform control. This outfit is being placed on the market by the Meliorate Manufacturing Company, 240-246 Hall Street, Brooklyn, N. Y.

Home Washing Machine

The Home Devices Corporation, Bush Terminal, Brooklyn, N. Y., has recently brought out several types of washing machines for both hand and electric operation in portable and stationary

ELECTRICALLY OPERATED WASHING MACHINE

types. The portable tubs are designed to occupy a small amount of floor space and are equipped with a strong and rustproof stand. The tub is mounted in such a way that by releasing a catch it may be tipped to one side with scarcely any effort and the dirty water quickly emptied. The washer is said to be especially suitable for homes where there are no stationary tubs.

The ⅛-hp. driving motor is equipped with a triple thread steel worm which runs in a bronze worm gear. The power is transmitted through a train of steel and bronze cut gears, to the moving parts of the outfit.

Generator for Aeroplane Wireless

In the accompanying illustration is shown special generators for wireless telephone transmitting and receiving apparatus which has been designed for use in aeroplanes only, by the Electric Specialty Company of Stamford, Conn. A combination of two direct-current

TWO GENERATORS MOUNTED IN SHELL

generators mounted in a torpedo-shaped shell is illustrated, one of the generators delivering low voltage for lighting the filament of the receiving audion, and the other delivers 1200 to 1500 volts, direct current for transmission. Both armatures are mounted on one shaft and supported at both ends by ball bearings. The outfit is intended to be driven by a small propeller.

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

BOILER CODE CONGRESS

State Supervision of Boiler Operation and Manufacture Favored by State and Municipal Representatives

The following resolution was unanimously adopted by the boiler code congress held at Washington, D. C., on Dec. 4 and 5: "Whereas, industry in every line of endeavor is very closely associated with steam as a motive power and the use of steam boilers; and whereas, obtainable statistics covering a period of years show that in the United States there is annually a loss of from 400 to 500 lives and the disablement of from 1000 to 3000 people due to explosions of steam boilers; and whereas, the government has recognized in the effort it has put forth in the safety movement that its first duty is the protection and safety of human life; and whereas, the federal government where it has the jurisdiction has prescribed rules for the construction of steam boilers; therefore, be it resolved, that it is the sense of this congress that all states should exercise supervision over the manufacture and use of steam boilers and all pressure vessels."

This subject was voted on only by persons having credentials from state or municipal executives. To show how well the A. S. M. E. boiler code is adapted to national adoption, John A. Stevens, chairman of the boiler code committee, explained how the code has been compiled. J. C. Callery, chief deputy of the division of boiler inspection, State of Ohio, presided.

KANSAS UTILITIES TO FRAME INDETERMINATE FRANCHISE

Affiliation with National Electric Light Association Considered and Problems of Lightly-Loaded Transmission Lines Discussed at Topeka

The Kansas Public Service Association held its nineteenth annual convention at the National Hotel of Topeka, Kan., Dec. 7 and 8. About 150 members attended. Among the more important topics brought up for action were the indeterminate franchise, iron-wire transmission lines and affiliation with the National Electric Light Association. In welcoming the members of the association, Mayor Jay E. House stated that he had found the public service officials to be the fairest and broadest-minded men he had the pleasure to deal with in public affairs.

W. N. Matthews, St. Louis, Mo., in a paper entitled "Good-Will—the Greatest Business Factor," emphasized the ways in which this intangible asset may be turned into cash by any central station. In building good-will every element that enters into it must be considered, namely, honesty, courtesy, promptness, fairness, charity and consideration.

E. T. Forman of Kansas City, representing the National Safety Council, spoke on "Accident Prevention," which was discussed by Mr. Ripley of Wichita.

G. B. Muldaur, field secretary of the National Electric Light Association, urged the association to affiliate with the national body, and acting on his suggestion a committee of three will be appointed by the incoming president to devise a plan of affiliation.

Indeterminate Franchise Law

At an evening meeting F. W. Blackmar, professor of economics at the University of Kansas, read a paper on the "Revocable Permit or Indeterminate Franchise," stating that such an agreement placed both the public and the company on their good behavior and gave the service corporation something to work for. Such a franchise he believes is preferable to either the short or the long-term franchise and is, in a very large number of instances at least, more desirable than municipal ownership.

In the discussion L. O. Ripley of Wichita, and H. P. Wright of Kansas City, Mo., stated that the old franchise system has caused most trouble in public service work. Under the laws of Kansas a charter cannot be taken out for less than fifty years and at the same time a franchise cannot be secured by a public service corporation for more than twenty years. Hence corporation work is necessarily crippled during the last years of the franchise if there is no assurance of a renewal. The revocable permit seems to offer corporations inducements to continue investing money.

Professor Shaad, head of the electrical engineering department of the University of Kansas, stated that the indeterminate franchise is the practical way out of a dilemma, and as the result of the discussion it was decided that an indeterminate franchise law should be drafted and that it should be brought before the next Legislature.

In a paper on "Joint Use of Electric Light and Telephone Poles," with slides to illustrate it, J. P. Kobrock, division plant engineer of the Missouri & Kansas Telephone Company at St. Joseph, Mo., cited as the monetary advantages of joint construction, the elimination of unsafe conditions, forestalling of public agitation for the removal of poles.

Charles A. Stanley, industrial engineer of the Kansas Gas & Electric Company, described the use of "Electric Power in the Oil Field," emphasizing the difficulties of securing business from the older oil men. His company now has 103 hp. in water pumping in the El Dorado field and in one instance was able to show a cost of $82.50 per month for electric operation as compared with a former steam cost of $321.20 per month.

Experience With Iron Wire in Kansas

C. A. Leland, Jr., of the Atchison Railway & Light Company, read a paper entitled "Transmission Lines Solve the Small Town Electric Lighting Problems." Part of the tendency toward municipal ownership in Kansas he attributed to the reluctance of utility companies to furnish service by transmission lines, and he suggested that iron wire might be used for lines operating at voltages of 13,200 and 6600, until such time as copper could be profitably substituted.

L. K. Green of Concordia, stated that he found No. 8 B B iron wire to be the most economical for connecting farm customers to transmission lines. His company connects farmhouses not more than 0.25 mile from its circuits, wires it with ten outlets, five switches, and

supplies a 1-kw. transformer, for a total of $250. Any greater load than this is taken at regular wiring rates. A minimum charge of $2 a month is made, with an added charge of 12 cents per kilowatt-hour for energy used above that amount.

C. E. Reid, professor of electrical engineering at Kansas State Agricultural College, said he considered that towns of 500 could profitably build from 20 to 25 miles of transmission line rather than build central stations of their own. He cited the instance of Norcatur, Kan., a town of 500 population, which has voted $22,000 bonds to build 20 miles of line to Oberlin. The city officials offered to put $50 worth of wiring in any house free of charge before connecting with the line, if, in turn, the customer would agree to use $50 worth of energy in one year. There are 140 houses in the town and to date 126 have accepted the offer.

Other papers and addresses were: "Protection of Transformers and Distribution System from Lightning, and Approved Practice of Grounding Secondaries," by J. E. Gossett, Topeka; "The Selection of Apparatus for Modern Steam Generating Stations," by Ernest Pragst, Schenectady; "Progress of Electrical Development," by F. P. Uhrig, Kansas City, and "Increasing the Central Station's Profit by Stopping a Leak," by A. MacLachlan, Detroit.

The following officers were elected: President, W. R. Waggoner, Salina; first vice-president, Otto Thies, Dodge City; second vice-president, H. L. Jackson, Minneapolis; third vice-president, C. L. Brown, Abilene.

NEW YORK EDISON RATES

Schedule Effective Jan. 1, 1917, Gives No Consideration to the Customer's Load Factor or Demand

A comparison of the rates of the New York Edison Company, effective Jan. 1, 1917, with those now in use is shown in the accompanying table. As will be noticed no consideration is given to the customer's load factor or demand, but that for each class of consumption an average rate is charged which evidently had as its basis the load factor and demand of the class as a whole.

GENERAL RATE

	Present Rate, Dec. 31, 1916 Kw.-Hr.		Proposed Rate, Jan. 1, 1917 Kw.-Hr.	
First	900 at	8 cents	900 at	7.5 cents
Next	100 at	7 cents	100 at	7 cents
Next	200 at	6 cents	300 at	6 cents
Next	300 at	5 cents	600 at	5 cents
Next	400 at	4.5 cents	600 at	4.5 cents
Excess over	1900 at	4.25 cents	Excess over 2500 at	4.25 cents

POWER RATE

	Present Rate, Dec. 31, 1916 Kw.-Hr.		Proposed Rate, Jan. 1, 1917 Kw.-Hr.	
First	450 at	8 cents	600 at	7.5 cents
Next	100 at	7 cents	100 at	7 cents
Next	1350 at	6 cents	700 at	6 cents
Excess over	1900 at	4.25 cents	800 at	5 cents
			1100 at	4.5 cents
			Excess over 3300 at	4.25 cents

Public Service Commission News

Illinois Commission

The rules for overhead electrical construction which have been established by the Public Utilities Commission has just been published. These rules and regulations apply to new construction or reconstruction of all overhead electrical lines located outside of buildings. In the case of existing construction, definite plans must be instituted which will eliminate all features not in agreement with these rules as expeditiously as practicable. In any event the necessary changes must be made within ten years.

"It is the intent of these rules," the commission states, "to make human safety a matter of primary consideration in the electrical construction to which they apply and to fix minimum requirements for such construction."

California Commission

In the consideration of proper rates to be charged for water by the Marine Water & Power Company the Railroad Commission laid down certain rules for valuation as follows:

In using a condemnation valuation as a basis for fixing rates, the value of non-operative structures and of lands not used or useful should be deducted; and the cost of additions and betterments, made subsequent to the original findings, added.

A water reservoir supplying a few customers who could be supplied without it at practically no additional expense should not be included in a rate valuation.

A depreciation annuity should be estimated on the sinking-fund basis in a rate case, where the required return is estimated on the cost to reproduce new on the historical method.

Taxes paid on non-operative property cannot be allowed as an operating expense in a rate case.

The rent of both of two offices of a water company cannot be charged to operating expenses in a rate case where the business can be properly handled from one.

The time of general officers of a water company should be properly apportioned between construction and replacements, in estimating maintenance and operating expenses in a rate case.

Maine Commission

In a complaint before the Public Utilities Commission alleging refusal on the part of the Winthrop & Wayne Light & Power Company to furnish rural service the commission required that the prospective electric consumers guarantee, as a condition of making the extension, an annual amount sufficient to provide for an allowance of only 2 per cent for a depreciation reserve fund of 25 per cent of the cost of the extension, rather than 5 per cent for straight line depreciation, since the company has no generating plant. The amount required to be guaranteed by applicants should be apportioned between them according to their individual uses and needs.

Since the utility should own all the service facilities the commission held that applicants for service should not be required to furnish the poles although the commission pointed out that it has no control over funds collected for poles by prospective consumers who have agreed to furnish poles if the electric utility will extend service to them. The commission has power to require an electric company, enjoying a monopoly, to make reasonable extensions.

It was further held by the commission that a request of eight prospective electric consumers for a 2-mile rural extension is reasonable, where all will light their houses, a majority their barns and outbuildings, and three will use power on their farms, and a proper guaranty is given. The electric company is entitled to a return of at least 6 per cent on rural extensions as a condition of making them, where rates fixed by the company yield a net return of 2.6 per cent, or an actual return of 5.8 per cent when bond interest is included, and money costs 6 per cent.

The contract to pay annual minimum amounts, required of applicants for extension, should be for ten years, with opportunity for readjustment at the end of any year, where there will probably be only eight customers and it is uncertain whether the guaranty is too small or too large.

Daylight-Saving Plan Favored by Chamber of Commerce.—Representatives of the United States Chamber of Commerce composing the "daylight-saving" committee are unanimously in favor of the adoption of the daylight-saving plan throughout the United States during summer months, according to an announcement made on Dec. 8 by Marcus M. Marks, chairman of the New York daylight-saving committee, at a meeting of the Pittsburgh Chamber of Commerce.

Great Northern May Turn Water-Power Sites Over to Montana Power Company.—It is reported on good authority that the Great Northern Railway Company contemplates turning over its water-power sites in the State of Washington, particularly that at Lake Chelan, to the Montana Power Company for development in its electrification plans. The Montana Power Company furnishes the power for the 400 miles of the Chicago, Milwaukee & St. Paul Railway electric road through Montana. The cost of developing the Lake Chelan site has been estimated at $2,000,000.

Urges Government Monopoly of Telephone.—Postmaster-General Burleson's annual report issued a week ago makes many recommendations for improvement of the service. Among them are these: That early action be taken by Congress declaring a government monopoly over all utilities for the public transmission of intelligence and that as soon as possible the telephone and telegraph facilities of the United States be incorporated into the postal establishment. That $300,000 be appropriated now for acquiring telegraph and telephone utilities in Alaska, Porto Rico and Hawaii.

Dinner to President-Elect Hollis, A. S. M. E.—Dr. Ira N. Hollis, president of the Worcester Polytechnic Institute and president-elect of the American Society of Mechanical Engineers, was tendered a dinner at the McAlpin Hotel on the evening of Dec. 8 by the New York Alumni Association. About 150 were in attendance. The speakers included Maj.-Gen. Leonard Wood, commander-in-chief of the United States Army, Department of the East; Rear-Admiral R. S. Griffin, engineer in chief of the United States Navy; Dr. M. E. Cooley, dean of engineering college, University of Michigan; Hudson Maxim, Dr. L. Baekland and Spencer Miller, members of the Naval Advisory Committee. Dr. Hollis emphasized particularly the responsibilities of the engineer to-day, calling attention to the need of having trained men behind the line in any plan of national defense which this country should undertake. He brought out the fact that war to-day, as has so often been said, is being conducted by the engineers. But he especially emphasized the fact that the engineer had an opportunity for patriotic service in the arts of peace as well as the arts of war, drawing his analogy from the pamphlet "The Moral Equivalent of War," by William James, which he stated every engineer should read.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Employees Oversubscribe Company's Stock Offer.—In accordance with a recent offer of the Public Service Corporation, Newark, N. J., to sell 4000 shares of stock to employees at $130 per share, on the instalment plan, 829 employees have taken advantage of the opportunity, resulting in an over-subscription of 359 shares, which the company has secured, or a total of 4359 shares, with a value of $562,311. The stock was sold at $129 per share instead of $130, as originally announced. With the subscriptions of 1913, when a like offer was made by the company, a total of 1656 employees are now shareholders, with an investment of approximately $1,000,000 in the company's stock. The present market value of the stock is $133 per share.

California Company Files Cooking Rates with Commission.—The Western States Gas & Electric Company has filed with the California Railroad Commission a schedule of rates for domestic electricity for cooking and heating. The new schedule gives a rate of 3.3 cents per kilowatt-hour for the first 70 kw. used per kilowatt installed, and a rate for the second block of electricity used of 1.6 cents per kilowatt-hour. On the rate given for cooking the company will allow power for heating and for electric irons, toasters, percolators and all the many electric attachments of the modern home except lighting. In addition to the low rate offered, 10 per cent will be discounted if the bills are paid within ten days after presentation.

Doherty Organization Backs the Slogan Sign.—One of the interesting innovations of the Doherty organization is the so-called slogan sign. In communities where it operates, it has been the practice of the Doherty organization to make a present to the city, through the local civic body, of an electric sign of large dimensions, and to supply the necessary current free of charge. A contest is held among the inhabitants for suggestions as to the best slogan for the new sign, and a valuable prize awarded the winner. At the formal turning on of the light, when the sign has been put into place, a celebration is held. Some of the signs in use in Doherty cities read as follows: "Danbury Crowns Them All," "Massillon Invites Industries," "You Will Do Better in Toledo," "Montgomery—Your Opportunity," "Elyria — 100 per Cent City," "St. Joseph — The City Worth While," "Try Alliance First," "Spend in the Tonawandas," "Durham —Renowned the World Around," "Galveston—the Treasure Island of America," "Bristol — Push — That's Bristol" and "Warren—City of Modern Methods."

Municipal Ownership Defeated at Omaha. — A contract involving extensive improvements to the street illumination of Omaha, proposed by the Omaha Electric Light & Power Company, was accepted by the people by a substantial majority at an election on Dec. 5. An exceptionally heavy vote was cast and the proposed street lighting contract was approved by the people in nine of the twelve wards of the city. The result is a defeat of municipal ownership agitation in Omaha.

Development of Gas-Fired Boilers Predicted.—In his inaugural address before the Manchester section of the British Institute of Electrical Engineers a short time ago, Chairman A. E. McKenzie stated that he believed that the large station of the future will have a proportion of gas-fired boiler units, the proportion being based upon the load factor in such manner that the extra capital incurred by the installation of by-product recovery plants will be remunerative and the by-products of the bulk of the fuel used recovered. Skilled analysis and extensive experience, he pointed out, tend to show that with improved forms of producers the aggregate value of by-products recoverable from coal by conversion to gas equals or exceeds the original coal value, and when extra capital and labor charges are taken into account the procedure leads to a substantial rebate on fuel costs. Gas-firing has not yet had its fair chance, in that practically every trial has been conducted with Lancashire or water-tube boilers converted. Obvious advantages incidental to gas-firing, according to Mr. McKenzie, will be the utilization of poorer grades of coal, and clean, comfortably controlled, smokeless boiler houses, involving low maintenance charges.

Tacoma Tentatively Agrees to Furnish Seattle With Power.—The City Council of Tacoma, Wash., tentatively agreed at a recent meeting to sell current to Seattle at the rate of 3.7 mills a kilowatt while repairs are being made on the Cedar River dam of the municipal power and lighting system. It is expected Seattle will need about 7000 kw. This deal will be consummated on condition that Seattle build a transmission line to connect with the Tacoma municipal plant, and that Tacoma be given free rein to furnish Tacoma manufacturing needs first. Tacoma does not want to be tied up with a time contract for a definite amount of current, because new manufacturing plants might be obtained, to which could be sold current at a more profitable figure. It has been estimated by Superintendent of Lighting J. D. Ross of Seattle that the cost of the connection would be approximately $125,000. The Council has asked Superintendent Ross to submit a report recommending the action he thinks advisable. In the conference with Tacoma officials on the proposition held recently it developed that Tacoma is under contract for fourteen years to the Puget Sound Traction, Light & Power Company, which draws on the municipal power supply when it needs power.

Cleveland League Hears About Electricity at Panama.—H. M. Morrison, consulting engineer, addressed the Electrical League of Cleveland on Dec. 14 on the topic "Electricity in the Construction and Operation of the Panama Canal."

Chicago Club Electrical Week Meeting. — Samuel Insull addressed America's Electrical Week meeting of the Chicago Electric Club—Jovian League. His address was devoted to reminiscences of his early experiences in the electrical business.

Luckiesh Addresses Chicago Illuminating Engineers.—On Dec. 8, M. Luckiesh, National Lamp Works, Cleveland, Ohio, spoke before the Chicago section of the Illuminating Engineering Society on the topic of "Linking Science and Art with Practice in Lighting."

Railroad Electrification Discussed at Toronto.—G. H. Hill, assistant engineer, railway and traction department, General Electric Company, on Dec. 15 spoke before the Toronto Section of the American Institute of Electrical Engineers on the subject "Railroad Electrification."

Cleveland Engineering Society.—W. R. Mott, illuminating engineer of the National Carbon Company, was scheduled to make an address before the Cleveland Engineering Society on the evening of Dec. 12. His subject was "Characteristics and Uses of the Flaming Arc."

Worcester Polytechnic Branch of Institute.—William J. Hammer, consulting electrical engineer, New York City, was the speaker at the Dec. 15 meeting of the Worcester Polytechnic Branch, A. I. E. E. His subject was "Selenium and Its Scientific and Industrial Applications."

National Convention of American Association of Engineers.—The American Association of Engineers will hold a national convention Feb. 8, 9 and 10, in Chicago, at the Hotel LaSalle. Work of a promotional nature will constitute the greater part of the program, which will be held under the slogan, "For the Good of the Engineer."

Portland Section of Institute Holds Meeting on Telephone Design. — The Portland, Ore., section of the American Institute of Electrical Engineers held a regular monthly meeting on Dec. 5 in the main auditorium of the local Y. M. C. A. W. E. Montrose, engineer of the Pacific Telephone & Telegraph Company, presented a paper entitled "Design of Outside Telephone Plant."

Meeting of Portland Electrical Men. —The fourth bi-weekly luncheon of the Portland, Ore., section of the American Institute of Electrical Engineers, National Electric Light Association and Oregon Society of Engineers was held at the Multnomah Hotel on Dec. 6. The luncheon was in charge of the Pacific Telephone & Telegraph Company, with W. D. Scott as chairman. J. H. Corcoran, division superintendent of traffic for the telephone company, gave an address on "The Telephone Girl at Her Work."

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Brooklyn Polytechnic Institute Branch, A. I. E. E.—A meeting of this branch was held on Dec. 15 in the Mailloux Library, Brooklyn. F. V. Magalhaes, superintendent of the meter department, New York Edison Company, spoke on the subject "Proper Metering of the Energy of a Central Station."

Chicago Engineers Discuss Relations of Capital and Labor.—At a meeting of the Western Society of Engineers, Dec. 4, George Weston of the Chicago Board of Supervising Engineers, delivered a paper entitled "Industrial Democracy with Particular Reference to the Relations Between Capital and Labor." "This subject," said Mr. Weston, "is one of leading importance to-day. It is one closely connected with the work of an engineer, for as a rule the consummation of his endeavors means the investment of capital and labor."

New York City Electrical Men See Liberty Lighting.—The New York section of the Illuminating Engineering Society and the New York Electrical Society held a meeting on Dec. 14 at which two papers were presented, one by H. H. Madgsick on "Lighting Liberty," and the other by T. C. Browne, entitled "What the Theater Expects from the Illuminating Engineer." In connection with the paper on the lighting of the the Statue of Liberty an inspection trip was made to the statue late in the afternoon of the meeting.

Radio Club of America.—The December meeting of the club was held on Dec. 15 at Columbia University, New York City. L. W. Stevens presented a paper on "Radio Laboratory Measurements and the Elimination of Radio Losses." High and low-frequency measurements, the determination of radio transmitter efficiency, the testing of radio receivers, and the general design of radio frequency apparatus were considered, emphasis being placed rather on practical application than upon involved theory.

Future Institute Meetings.—The following is a schedule of future meetings of the American Institute of Electrical Engineers as far as decided upon: Pittsburgh, Pa., Jan. 12, 1917. A paper entitled "Regenerative Braking of Electrical Vehicles" to be presented by Mr. R. E. Hellmund; New York, Feb. 7, 8, 9, 1917, midwinter convention; Chicago, Ill., March 9, 1917; Schenectady, N. Y., April 13, 1917; New York, May 18, 1917, annual meeting. The annual convention will be held during the week beginning June 25, 1917. The place for holding the convention has not yet been decided upon. The Pacific Coast convention of 1917 will be held in Los Angeles, Cal., at a date to be announced.

Northern White Cedar Meeting.—The annual meeting of the Northern White Cedar Association will be held at the Hotel Radisson, Minneapolis, Minn., on Jan. 30 and 31, 1917. As has been customary in the past no program has been arranged and matters will be considered in the regular order of business.

American Association for the Advancement of Science.—The association and about forty national scientific societies affiliated with it will meet in New York City from Dec. 26 to 30, 1916, under the auspices of Columbia University, New York University, the College of the City of New York, The American Museum of Natural History and the other scientific and educational institutions of the city. Dr. Charles R. Van Hise, president of the University of Wisconsin, will preside. The address of the retiring president will be given by Dr. William Wallace Campbell, director of the Lick Observatory. An effort is being made to increase the membership of the association by waiving the entrance fee in the case of those belonging to affiliated societies. The association's membership is now nearly 11,000.

Meetings of Iron and Steel Electrical Engineers.—The regular monthly meeting of the Association of Iron and Steel Electrical Engineers was held on Dec. 16 at the Fort Pitt Hotel, Pittsburgh, Pa., under the direction of the standardization committee, of which F. D. Egan is chairman. The January meeting of the Pittsburgh section will be held on Jan. 20 at the Fort Pitt Hotel. Papers on the subject "Direct-Current and Alternating-Current Automatic Skip and Bell Hoists" will be presented by H. D. James, Westinghouse Electric & Manufacturing Company; Frank Smith, Otis Elevator Company; R. H. McLain, General Electric Company, and F. J. Burd, the Cutler-Hammer Manufacturing Company. The Philadelphia section will hold its next meeting at the Majestic Hotel on Jan. 6. Will J. Davis, Jr., American Lighting Company, will present a paper on "Industrial Flood-Lighting; Its Origination and Application."

Independent Telephone Convention.—The annual meeting of the United States Independent Telephone Association was held from Dec. 5 to 8 at the Hotel La Salle, Chicago. President C. Y. McVey, Cleveland, opened the convention by calling on W. R. Moss of Chicago for the address of welcome, to which response was made by William Fortune, Indianapolis. President McVey in his brief address brought to the attention of the convention the problems in Federal legislation now confronting interstate utilities. The remainder of the program was carried out as announced in the **Electrical World** for Dec. 2. The following officers were elected to serve for the ensuing year: Chairman of board, E. B. Fisher, Grand Rapids; president, C. Y. McVey, Cleveland; vice-presidents, W. H. Bryant, Mobile, G. W. Robinson, St. Paul, and F. B. MacKinnon, Washington; secretary-treasurer, W. S. Vivian, Chicago.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

ELECTRICAL MANUFACTURERS GRANT EMPLOYEES BONUSES

Recognition Taken by Employers of High Cost of Living Increases Income of Thousands of Wage Earners

In recognition of the fact that the purchasing power of the dollar to-day is considerably less than it was before the war in the matter of food and fuel, numbers of employers have been quick to respond to the needs of their employees. Among the number are some well-known electrical manufacturing concerns. The General Electric's plan was announced this week and the others earlier.

According to the plan of the General Electric Company each employee receiving $2,500 per year or less will receive a monthly bonus of 10 per cent of his monthly salary. This is in addition to the bonus plan announced by the company last August whereby employees share semi-annually in the profits.

The present plan will affect about 60,000 employees and will increase the company's payroll by about $500,000 a month or $6,000,000 annually.

In addition to an extra dividend to stockholders the Ward Leonard Electric Company has announced a profit-sharing plan whereby employees will receive more pay during the period of higher living costs. Between 300 and 400 em ployees are affected by this arrangement. The statement made by the company and signed by L. Kebler, president, follows in part:

"On Dec. 23, 1916, the Ward Leonard Electric Company will pay an extra dividend to its stockholders of 2 per cent. At that time it will pay to each employee a bonus of 2 per cent on what he or she has received from day work, piece work and salaries, during the preceding year. About a month later, or Feb. 1, 1917, and each month thereafter until present conditions of high cost of living and of active business become changed, a bonus of 10 per cent will be paid to each employee based on his or her earnings from the same sources during the preceding month. This will continue until notice is given to the contrary."

The bonus plan announced on Nov. 1 by the Westinghouse Electric & Manufacturing Company for East Pittsburgh salaried men has been enlarged to cover all offices as of Dec. 1. The plan has been in effect with the workmen since the fall of 1915.

SPECIAL DISCOUNTS ON ELECTRIC TRUCKS

Another Large Manufacturer Gives Tangible Evidence of Desire to Co-operate with Central Stations

The plan suggested by the National Electric Light Association for granting special discounts on electric commercial cars to central stations as announced in last week's issue of the ELECTRICAL WORLD, page 1168, is spreading. In addition to the General Vehicle Company the Walker Vehicle Company of Chicago is offering special net prices on its full line of Walker drive chassis from 1000 lb. to 5 ton capacity. Also the Walker company is offering a special price on the nickel-iron and lead type batteries for use with these chassis, and in addition is offering specially developed bodies for the various departments of the central station business at attractive prices.

These prices, which will be quoted on request, apply only to cars ordered for delivery during the first half of the year 1917.

The General Vehicle plan, as announced last week, it will be remembered, based its discounts on the cumulative purchases of all participating in the plan. The plan announced by the Walker company is a flat discount, irrespective of the purchases of other central stations.

EFFECT OF PEACE ON MARKET FOR ELECTRICAL GOODS

American Manufacturers Faced with Uncertainties —European Rehabilitation a Large Factor—Domestic Market Contingent on Lower Prices

Early this week the world was roused by the Teutonic Allies' peace proposition, and immediately speculation was astir regarding the possible effect such a move, if successful, would have on the different markets in this country. Particular interest attaches to the market for electrical manufacturers. The amount of factory space now devoted to the manufacture of munitions that ordinarily is taken up with the fabrication of electrical goods is undoubtably negligible. On the other hand, the space devoted to the manufacture of electrical equipment ordered for use either directly or indirectly in the manufacture of munitions is by no means negligible.

Numerous munitions plants sprung up like mushrooms during 1915, and were generally electrically equipped. In the event of peace it is quite probable that these plants will cease to manufacture munitions for European countries. The United States might contract for the output of these plants for a limited period, but eventually they will either be abandoned or devoted largely to the manufacture of merchandise of a more peaceful nature.

It is doubtful if the market for the latter will long continue large enough to absorb the entire output of so many plants. In this case that which electrical manufacturers fear will follow: There will be dumped on the market large quantities of motors, transformers, protective equipment, etc., that have been used for a year or more, and which are almost like new, at prices considerably below the market quotations for new apparatus.

On the other hand, should the market for peaceful manufactures continue it is highly probable that it will in a large measure be the result again of European purchasing, this time for rehabilitation. Rehabilitation is necessary in this country, but it will wait for lower prices. Europe cannot wait, but will commence its reconstruction immediately on the declaration of peace.

Electricity is going to play a tremendous part in the rebuilding of Europe. The loss to industry of 25,000,000 able-bodied men will register its effect on processes of manufacture. Where labor once was cheap, it will be sufficiently expensive to warrant the expenditure of huge sums of money in more efficient labor-saving machinery. The motive power in practically every instance will be electricity, for two reasons—its efficiency and the price of coal.

Furthermore, European generating systems have suffered as a result of the war. Zinc and iron have been substituted for copper transmission wire, and plants have been worked to the limit, thereby increasing wear and tear.

It is doubtful if the industrial plants of the belligerent nations will be in a position to start on peaceful manufactures immediately after peace is declared. It will take some time to disband the armies and afterward for the men to accustom themselves to industrial life again. During this time it is felt very strongly that the products of American factories will find a ready market. Particularly will this be true of electrical goods, as the high quality of

engineering involved in the manufacture of American electrical products is recognized the world over.

In the United States the domestic demand for electrical goods after the war, it is felt, will largely be regulated by price. So long as the factories have a volume of orders greater than production facilities, and the price of raw materials is maintained, no drop in prices can be expected. Metal prices, it is felt, will continue high until after the middle of 1917, should peace be declared before then, after which time the price would probably slowly fall off, keeping pace with the demand.

When prices fall, the principal demand in the United States will come from the central stations and from domestic customers. Many plans for improvements and enlargement are being held up now until better prices prevail. Furthermore, the average domestic customer will look on appliances and house-wiring prices as bargains when the price begins to fall, and will therefore become a mighty factor in the electrical market.

WESTINGHOUSE TO BUILD PLANT ON THE DELAWARE

Plans Call for the Expenditure of Between $5,000,000 and $7,000,000 to Provide for Additional Manufacturing Facilities

Arrangements have been made by the Westinghouse Electric & Manufacturing Company for starting at once the construction of an immense factory on the Delaware River, not far from Philadelphia. It has been reported that the plant will employ upward of 15,000 men.

A statement issued on Wednesday by Guy E. Tripp, chairman of the board of directors, reads as follows: "The company's facilities are now taxed to capacity to manufacture its regular products, and in spite of the vigorous effort which has brought production to its present record output, it has been found impossible to keep pace with the growing demand so that much profitable business offered has had to be declined.

"Unfilled orders on hand for the regular products of the company, that is to say exclusive of rifle or shell contracts, amount to over $31,000,000, which is by far the largest amount the company has ever had on its books.

"There are many factors contributing to this condition. Improvements in the large steam electric generating units have led to great increases in central station capacity near manufacturing centers, and have made profitable the sale of electric current at rates which have so stimulated consumption as to create an enormous demand for industrial motors. The coal shortage of the last six months has emphasized the comparative handicap under which the small steam plant suffers and can hardly fail to further accelerate the movement to substitute central station service for isolated plants.

"Increased attention is being directed toward hydroelectric developments, and pending legislation in Congress is designed to stimulate such construction. Coming activities in this direction should not be overlooked.

"In railroading practically every class of heavy service is now performed successfully by electric power, and this field promises to be one of rapid expansion.

"Not only has the steam turbine practically supplanted the reciprocating engine in electric power plants, but it has also invaded the field of ship propulsion to an extent which indicates a similar almost universal and abnormally rapid adoption, both by direct steam drive as well as by the electric drive, contemplated in the United States naval program.

"For the foregoing and other contributing causes it is reasonable to expect that the present large volume of the company's regular business will not only be maintained but will be materially increased. To provide the additional manufacturing facilities needed there has been purchased on the Delaware River at Essington, Pa., just outside of Philadelphia, a tract of land having a deep water frontage and large enough to accommodate an ultimate factory development, several times as great as that of the East Pittsburgh works. It is planned to begin immediately the erection on this land of a new plant to cost between $5,000,000 and $7,000,000."

ENORMOUS MARKET EXISTS FOR COPPER WIRE

Volume of Business Almost Entirely Domestic, with Demand from Middle West—Buying for Work in Hand

Insulated copper wire manufacturers are faced with a market greater than they can supply. Mills are working at maximum pressure night and day and still the demand exceeds the supply. Practically the entire volume of this business is for domestic use, very little copper wire being exported. From the Middle West in particular is the demand for insulated wire large.

In certain sizes the orders are very heavy and the supply small. Stranded wire, it is understood, is very scarce, and is more difficult to obtain than solid conductor.

Distributors of wire are of the opinion that the buying is for actual construction work or other work in hand. It is felt that very little or no buying is being done to cover possible future requirements.

Prices, of course, have gone beyond all past peaks. With copper selling at 35.75 cents and copper wire base at about 5 cents higher, insulated wire has naturally increased to a still higher plane. Furthermore, insulation is much more expensive and difficult to obtain. Nevertheless, there seems to be no hesitation on the part of the buyer to pay the price provided he can get delivery. Price is of second consideration, delivery first.

There appears to be a large discrepancy in quotations on the selling base of code wire. A difference of about 5 cents exists between the high and the low. This difference, however, it is understood, is due to a difference in discount. With the advance in price some manufacturers preferred to increase the price by cutting the discount rather than by increasing the selling base.

The December issue of *The Wire Message*, published by the Habirshaw Electric Cable Company and the Electric Cable Company, in summing up the copper wire situation, said:

"We can see nothing in the copper situation to justify the hope of lower prices in the near future; on the contrary there are many indications that point to higher values."

Reports to these companies on local markets from correspondents follow:

San Francisco—Business good. Considerable conservative buying on account of high prices. Great difficulty in obtaining proper stock is handicapping sales.

Salt Lake City—Principal trouble is to secure stock. Can sell at prevailing prices all that can be obtained.

Omaha—Building good. New hotel, a fifteen-story office building and many apartment houses to be constructed. Large corporations making liberal budgets for next year. Big demand for insulated wire in spite of prevailing high prices.

St. Louis—Delivery the most important factor. Most manufacturers require six to eight weeks. High-priced copper has stimulated market. Jobber now on profitable basis, owing to rapid advance in value of stock on hand and contracted for.

Minneapolis—Deliveries interfering with development of jobs. Big demand exists for high-tension cables and park cables.

Kansas City—Increasingly heavy demand not only for 14 B & S, but for larger sizes. Expansion in oil and gas fields promises great activity for 1917. Demand for wires and cables exceeds supply.

Chicago—No protection orders being accepted. Buying largely for actual requirements. Competition keen and some low prices up to ten days ago. Difficulty in getting stock has stopped this and raised prices. Rumored that railroads will curtail purchases but general outlook good for large business.

Pittsburgh—Business good but shortage of material a serious handicap. Distributing wire in small lots.

Boston—Future bright but high prices are tending to cause conservative buying and to retard central station development. Deliveries very poor.

Buffalo—No change during month of November. Outlook good.

Manufacturing and Industrial

Economy Fuse and Manufacturing Company of Chicago has opened a branch sales office in Seattle, at 936 Henry Building. W. E. Jones is district sales manager for the Pacific Northwest.

The American Appliances & Machinery Manufacturing Company announces that after Dec. 15 it will occupy its new factory building at 161 Jamaica Avenue, Brooklyn, N. Y. The building contains 4500 sq. ft. of floor space.

Hotpoint Raises Prices.—The Hotpoint Electric Heating Company, owing to the continued increase in raw material costs, has advanced the price of its radiant stove to $4.50, effective Dec. 1. On Jan. 1 the price of the company's vacuum cleaner will be advanced to $27.50.

The Electric Heating & Manufacturing Company's plant at 1812 Ninth Avenue South, Seattle, Wash., was partially destroyed by fire on Dec. 3. The plant was fully covered by insurance and production will be resumed as soon as the structure can be rebuilt and damaged equipment replaced.

Precision Die Casting Company, Syracuse, N. Y., announces that the entire business of the Van Wagner Die Casting Corporation and the Precision Die Casting Company has been purchased from Charles Van Wagner, and the two companies will be merged into the Precision Die Casting Company, Inc.

Paducah (Ky.) Pole & Timber Company has completed its new plant at Bondurant, Ky., erected for the manufacture of crossarms. The output of this plant, it is expected, will soon reach 5000 10-ft. crossarms per day. Already the company has contracted for 20,000,000 ft. of cypress stumpage, from which crossarms will be made.

Pittsfield G. E. Plant Increase.—The General Electric Company has purchased the factory of the former Triumph Voting Machine Company at Pittsfield, Mass., containing 45,000 sq. ft. of floor space. About 300 hands will probably be employed, and the departments of wire covering and enameling will be transferred from the Morningside plant of the company.

The Hoover Suction Sweeper Company has just completed a new plant at New Berlin, Ohio, which will triple the capacity for manufacturing and quadruple the floor space. It is reputed to be the largest plant in the world devoted exclusively to the manufacture of suction sweepers. With the exception of the motors, all parts of the sweeper will be made in this plant, where they will be assembled. The sales organization will also have its headquarters in the building.

The Chelten Electric Company, manufacturers of electrical specialties, 314 Armat Street, Philadelphia, Pa., has recently purchased a large piece of ground on which it is about to build a five-story factory to take care of the increased business. This factory will have floor space between 40,000 and 50,000 sq. ft. As soon as the company is in its new building it intends to add extensively to its present line of house-wiring and lighting specialties. The company expects to be in the new factory well before the fall of next year.

C & C Company in Receiver's Hands.—W. E. Tuttle, Jr., has been appointed receiver for the C & C Electric & Manufacturing Company in an action brought by the American Brass Company in behalf of itself and all other creditors. In a statement dated Dec. 11 the receiver says: "This is not a bankruptcy proceeding, nor is it a suit to dissolve this corporation. The company admitted the allegations in the bill of complaint, placed its interests under the protection of the court, and consented to the appointment of a receiver. The business will be continued without the slightest interruption, and, in fact, more vigorously than heretofore, because, as receiver, I can obtain materials to finish up quickly the work in progress. I am now taking steps to complete the work on all pending orders, and will make shipments at the earliest possible date, with the expectation of keeping all promises made by the company as to deliveries. Milton W. Franklin has been continued in charge as general manager, and C. H. Florandin as general sales manager."

W. R. Garton Company, Chicago, will change its name on Jan. 1 to the Electrical Material Company. In the new organization Mr. Lewis, for ten years the company's sales representative in the Iowa district, will be vice-president of the company, and Mr. Traner, auditor and credit manager of the old concern for almost ten years, will be the treasurer of the new concern. Ray P. Lee, one of the founders of the business, will continue as president, and Mr. Henderson as secretary. When the firm name is changed the new concern expects to move to larger quarters at 618 West Jackson Boulevard. The company will continue to represent the same manufacturers it has in the past, and in addition will add to its line from time to time material which will enable it to engage as extensively in business in the electric-lighting field as it has in the electric-railway and mining-supply fields. The company will cover the six States of Minnesota, Iowa, Wisconsin, Illinois, Michigan and Indiana.

Demand for Chestnut Poles No Longer Local.—That utility companies generally are becoming better acquainted with chestnut poles is evidenced by the fact that when this company first started in business the demand for its product was entirely a local one, according to John L. Fay, sales manager of the Paducah Pole & Timber Company. Gradually, however, utility companies not in the immediate vicinity of the chestnut forests began to erect chestnut poles, as time proved the strengh and life of the product. The use of these poles is now almost nation wide. "The present heavy demand for chestnut poles, I believe," said Mr. Fay, "has been brought about by the general movement toward centralization of power generation sources and the consequent necessity of building transmission lines to tie in towns formerly served by local plants. The additional fact that the Bureau of Standards has recently called close attention to the detailed specifications for transmission and distribution lines has stimulated interest in chestnut poles. A report made by R. S. Kellogg of the United States Department of Agriculture also shows to what extent chestnut poles are being used. Mr. Kellogg indicates that one-fourth of all the poles now erected by utility companies in the United States are chestnut poles. When this fact, together with the information that 3,500,000 round poles exceeding 20 ft. in length are used annually in this country by telephone, telegraph and electric railway, light and power companies, is considered, it will be seen that the future supply of poles must be given consideration. With this thought in mind this company recently acquired an additional pole yard about 20 acres in size. In it we are installing 1.75 miles of railroad track, a steam locomotive derrick, special loading devices and an open-tank treating plant. There are now about 300,000 poles in this yard ranging from 20 ft. to 75 ft. in length. Notwithstanding the fact that the company owns more than 15,000 acres of chestnut timber land, it has acquired even greater quantities of chestnut pole stumpage. Through the care of this latter area it will be able to supply the demand for chestnut poles for many years to come."

NEW YORK METAL MARKET PRICES

	Dec. 5 — Selling Prices		Dec. 12 — Selling Prices	
Copper	Bid	Asked	Bid	Asked
	£ s d		£ s d	
London standard spot	152 0 0†		148 0 0†	
Prime Lake	33.75	to 34.25†	34.50	to 35.00†
Electrolytic	35.00	to 35.50†	35.00	to 35.50†
Casting	33.00	to 33.50†	33.00	to 33.50†
Copper wire base		40.00†		40.00†
Lead		7.50		7.50
Nickel		50.00		50.00
Sheet zinc, f.o.b. smelter		21.00		21.00
Spelter, spot	12.67½	to 12.92½	12.05	to 12.30
Tin, straits		44.50		43.00
Aluminum, 98 to 99 per cent.	58.00	to 60.00†	59.00	to 61.00†

OLD METALS

Heavy copper and wire	27.00	to 28.50†	27.00	to 28.50†
Brass, heavy	16.00	to 17.00†	17.00	to 18.00†
Brass, light	13.00	to 13.25†	13.00	to 13.25†
Lead, heavy	6.50	to 6.62½†	6.75	to 6.87½†
Zinc, scrap	9.00	to 9.25†	8.50	to 9.00†

COPPER EXPORTS

Total tons to Dec. 12 8,925

†Nominal.

Corporate and Financial

American Telephone & Telegraph Company, New York, N. Y.—An issue of $80,000,000 of thirty-year 5 per cent collateral trust gold bonds due on Dec. 1, 1946, has been subscribed for at 98 and interest. A sinking fund of 1 per cent is to be set aside annually for the retirement of bonds by purchase in the open market or by call at 105 and interest.

Colorado Power Company, Denver, Col.—At the recent meeting of the directors it was decided to make common stock dividends payable quarterly. Heretofore they have been payable semi-annually.

Consolidated Gas, Electric Light & Power Company of Baltimore, Md.—An issue of $4,800,000 of general mortgage 4.5 per cent gold bonds due on Feb. 14, 1935, is being offered at 93 and interest. The proceeds from the sale of the bonds will be used in part to reimburse the company for the purchase and retirement of the 5 per cent debenture stock formerly held abroad and to provide the company with additional funds for extensions and other corporate purposes.

Electric Bond & Share Company, New York, N. Y.—A new issue of $2,000,000 of 6 per cent cumulative preferred stock is being offered at 100 and dividend.

Kings County Electric Light & Power Company, Brooklyn, N. Y.—An order has been issued by the Public Service Commission for the First District of New York permitting the company to issue $2,500,000 of convertible debentures, and its subsidiary the Edison Electric Illuminating Company of Brooklyn to issue its demand notes for $1,900,000. In permitting the two issues the Public Service Commission has thrown about them several protective conditions. The proceedings of the debenture issue are to be used to reimburse the treasury of the Kings County company for $600,000 expended from income for improvements from Sept. 30, 1912, to Sept. 30, 1914, and to acquire $1,900,000 in demand notes of the Edison company. The purpose of the demand notes is to pay off $600,000 of promissory notes to banks and to reimburse the Edison company's treasury for expenditures amounting to $1,300,000. This sum was spent for improvements on the Edison company's property between the above dates.

Northern Iowa Gas & Electric Company, Humboldt, Iowa.—An issue of $100,000 of 7 per cent cumulative preferred stock is being offered at 97 and accrued dividend.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.—Pursuant to a resolution of the board of directors, but subject to authorization by the stockholders at a special meeting, which has been called to convene at the chief office of the company at East Pittsburgh, Pa., on Feb. 15, 1917, the privilege is given to the holders of the preferred and common stock of the company to subscribe on or before Feb. 21, 1917, at $50.18 per share, being the equivalent of par value, plus accrued dividends at the current rate of 6 per cent per annum to Feb. 21, 1917, from Jan. 31, 1917, when dividends on the new stock will begin to accrue, for an amount of common stock of the company equal to 25 per cent of the par value of their respective holdings of stock of the company as registered on its books at the close of business, Dec. 30, 1916. Kuhn, Loeb & Company have agreed to form a syndicate which is to take so much of the stock as is not subscribed for by the stockholders. It is proposed to issue approximately $15,000,000 shares of common stock for the purpose principally of financing the business that will be handled by a new $7,000,000 plant to be constructed on the banks of the Delaware River, and to which reference will be found elsewhere in this issue. In a statement, Guy E. Tripp, chairman of the board of directors, said: "The company's net profits for the seven months ended Oct. 31, 1916, after deducting all interest charges, were $7,651,010.37. During the early months of this period large amounts were written off for depreciation on special tools and other facilities acquired in connection with contracts for the machining of shells. These items have now been substantially all absorbed, so that the company's net income from all sources, after deducting interest charges, is now averaging more than $1,600,000 per month. A continuance of this rate would close the fiscal year ending March 31, 1917, with a profit of over $15,000,000, equal to 25 per cent on the entire share capital of the company now outstanding."

New Utility and Industrial Companies

The Electric Freezing System of Detroit, Mich., has been incorporated with a capital stock of $10,000 by Henry J. Berry, Reuben J. White, George Moebs and others.

The Fuse Electric Fire & Burglar Alarm Company of Wheeling, Mo., has been chartered with a capital stock of $30,000 by A. E. Lowe, Thomas J. Lilly and W. S. Cherry.

The Bernard Kapstein Company of Boston, Mass., has been incorporated by Joseph Bearson, Edward M. Kapstein and E. I. Newstadt. The company is capitalized at $25,000 and proposes to deal in electrical supplies.

The Detroit Closed Fuse Bushing Company of Detroit, Mich., has been incorporated with a capital stock of $15,000 by H. E. Watson, Frank M. Hydon and William Short. The company proposes to manufacture closed bushings and electrical and mechanical devices.

Trade Publications

Electric Ranges.—The Estate Stove Company, Hamilton, Ohio, has recently issued an illustrated folder on electric cooking.

Reflectors.—"Reflectors for Industrial Lighting" is the title of a leaflet issued by the Hubbell Company of Bridgeport, Conn.

Armored Cables.—The General Electric Company, Schenectady, N. Y., has recently sent out bulletin No. 49,300 descriptive of armored cables. Several styles of armored cables suitable for use under the various conditions which are encountered in connection with the transmission of electrical energy are described.

Oil Plants.—The Gilbert & Barker Manufacturing Company of Springfield, Mass., has recently distributed a bulletin on the Gilbert & Barker process for burning fuel oil under low pressure. The bulletin is carefully illustrated and prepared, and also contains tables showing comparison of oil fuel with various gaseous fuels.

Pipes.—Catalog No. 14 descriptive of pipes manufactured by the National Tank & Pipe Company of Portland, Ore., is now ready for distribution. This catalog contains several colored views of pipe lines installed by this company. Interesting tables and information not usually found in catalogs are published. This catalog ought to be of interest to every engineer interested in wood pipe construction.

Appliances.—The Hotpoint Electric Heating Company of Ontario, Cal., has prepared a sales help bulletin on "How Hotpoint Santa Will Bring Profits Down Your Chimney." The purpose of this book is to give in concise, handy, pocket-form, complete information regarding the Hotpoint merchandising plans for the holidays—to tell what is being offered in merchandising; how it is being advertised.

Oil Engines.—The engineering experiment station of Iowa State College, Ames, Iowa, has just begun the distribution of bulletin 42, which is a 160-page study of oil engines in Iowa power plants written by H. W. Wagner. The bulletin contains data taken from tests of ten oil-engine plants in Iowa, and operating costs secured from many other stations. It also points out solutions of operating problems that arise in connection with oil engines.

Pole Jacks.—The Templeton, Kenly & Company, Ltd., 1020 South Central Avenue, Chicago, Ill., is distributing an eight-page broadside descriptive of its newest patent jack—the No. 318 Simplex pole jack—designed especially for pulling, straightening and reinforcing telephone, trolley and lighting posts. This is the latest addition to the Simplex jack family, which includes jacks for railroads, industrial and automobile purposes.

Coal-conveying Equipment.—The Link-Belt Company of Chicago has just issued bulletins Nos. 288, 293 and 396, which describe and illustrate respectively the coal-conveying equipment of the W. H. Grundy Company's power plant at Bristol, Pa.; the coal and ash-handling machinery at the power plant of the Victor Talking Machine Company, Camden, N. J.; and the water-intake screens at the Philadelphia (Pa.) Electric Light Company's plant.

New England

SOUTH BERWICK, ME.—The Berwick & Salmon Falls Electric Company has petitioned the Public Utilities Commission for permission to issue stocks and bonds to provide funds to carry out a contract with the South Berwick Realty Corporation for the purchase and development of a water power.

ASHLAND, N. H.—At an election held recently the proposal to establish a municipal electric plant in Ashland was carried.

DOVER, N. H.—The Twin State Gas & Electric Company contemplates extending its electric transmission lines to Milton Mills and Union.

JEFFERSON, N. H.—The Bethlehem (N. H.) Electric Light Company is erecting a temporary electric transmission line to extend its service to the town of Jefferson.

MILTON, N. H.—Plans are being prepared by the Twin State Gas & Electric Company of Dover for the construction of a hydroelectric power plant at Milton, to cost about $25,000.

BARRE, VT.—The Central Power Corporation of Vermont, which is applying for a franchise in Barre, has announced that it has made arrangements with the Ontario Paper Company to purchase 5 000,000 kw. hours per annum, to be used as a reserve power for service in Barre and Montpelier. This power will be developed on the Green River work on which will begin at once, providing the price of materials is not prohibitive. Warren Curtis, Jr., is consulting engineer of the Ontario Paper Company. Charles H. Thompson of Montpelier is general manager of the power company.

PAWTUCKET, R. I.—Plans are beng considered by the Jencks Spinning Company for the construction of a power house, 100 ft. by 100 ft., on Weedon Street.

Middle Atlantic

BUFFALO, N. Y.—The school board has recommended that the present system of indirect lighting in the Technical High School be changed so that more light may be obtained.

CANISTEO, N. Y.—The Canisteo Light & Power Company has applied to the Public Service Commission for permission to erect an electric transmission line in the village of Canisteo and for approval of the exercise of rights and privileges under a franchise granted to Charles A. Larrowe by the village of Canisteo and a transfer of the franchise to the company.

COHOES. N. Y.—The Cohoes Light & Power Company, recently incorporated, has applied to the Public Service Commission for permission to issue $2,500,000 in capital stock and $2 500,000 in bonds, the proceeds to be used to acquire the property of the old Cohoes company and the Cohoes Gas Light Company.

CUBA, N. Y.—The Cuba Electric Company contemplates extending its electric transmission line to Rushford. Electrical service will also be supplied to farmers residing along the proposed line.

ANNVILLE, PA.—H. E. Millard, it is reported, is contemplating the construction of an electric power plant.

BETHEL, PA.—The Blue Mountain Electric Company has entered into a contract with the Edison Electric Illuminating Company of Lebanon for electrical energy for a period of fifteen years. The Edison company will extend its electric transmission lines 2¼ miles from Myerstown, where connection will be made with the lines of the Blue Mountain company. Electricity will be delivered at 13,000 volts. Upon completion of the line the Blue Mountain company will abandon its present plant (operated by water power) near Rehrersburg.

HAZLETON, PA.—The Lehigh Coal & Navigation Comany contemplates the installation of a complete electrical equipment for operating its Cranberry mines, recently acquired from A. Pardee & Company.

PHILADELPHIA, PA.—Bids will be received at the Bureau of Supplies and Accounts, Washington, D. C., until Dec. 19, for furnishing at the navy yard, Philadelphia, Pa., generating sets, riveting and punching machines. Further information may be obtained upon application to the navy yard named or the above bureau.

BAYONNE, N. J.—The City Commissioners have authorized the extension of the ornamental street-lighting system on Broadway, a portion of which was recently placed in service. The commissioners are also considering the extension of the system from Broadway to the canal bridge.

HACKENSACK, N. J.—The Board of Freeholders has granted the New York Telephone Company permission to construct underground conduits and subways from Hackensack River to Hoboken Road.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

HIGHTSTOWN, N. J.—The Electric Light & Power Company has inaugurated a 24-hour service, effective with the operation of a new 13,000-volt transmission line to Trenton, connecting with the system of the Public Service Electric Company. The company plans improvements to the local system, including the installation of new transformers.

NEWTON, N. J.—The Town Committee is negotiating with the Newton Gas & Electric Company for an electric street-lighting service. An electric-lighting system will be installed at the skating rink near West End Avenue.

SECURITY, MD.—The Hagerstown & Frederick Railway Company of Frederick is planning to install a 5000-kw. generator, condensers, boilers, etc., at its power plant in Security.

SPARROWS POINT. MD.—The Bethlehem Steel Company has awarded the contract for construction of new buildings at Sparrows Point, including a gas-driven engine generating house and a gas blower engine house, to the Irwin & Leighton Company, 126 North Twelfth Street, Philadelphia. The cost of the work is estimated at $900.000.

BRISTOL, VA.—Plans are being considered by Charles F. Hagan to develop water powers which he controls to generate electricity, which will be transmitted to a coal mining section.

NORFOLK, VA.—The Southern Transportation Company, Commercial Trust Building, Philadelphia, Pa., has purchased a site on the eastern branch of Elizabeth River, on which it will erect a plant for construction and repair of barges, tugs and other vessels, to cost about $200,000. Plans are being prepared for erection of woodworking, carpenter and machine shops, steam and electric plants, etc.

STAUNTON, VA.—The Blue Ridge Light & Power Company is contemplating an extension to its system in Staunton.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Boston, Mass., Schedule 502—three engine room clocks, etc.; Schedule 501—one electric overhead crane; Schedule 491—miscellaneous safety and relief valves. Newport, R. I., Schedule 486—1300 lb. sheet copper; Schedule 499—20,000 ft. platinum iridium wire. Brooklyn, N. Y., Schedule 490—indicator systems, etc. Applications for proposals blanks should designate the schedule desired by number.

North Central

LANSING, MICH.—The Rickman Construction Company of Lansing has been awarded the general contract for the construction of a 77-apartment building to be erected at the corner of Lenawee and Townsend streets. Contracts for heating, plumbing and lighting have not yet been awarded.

CANTON, OHIO.—The Canton Electric Company has been granted a permit to erect a garage and storehouse at its plant at Second Street and Commerce Avenue, to cost about $30.000.

EAST PALESTINE, OHIO.—The contract for construction of power plant and pumping station in East Palestine has been awarded to J. G. Madden of this city. W. C. Owens & Company, 1900 Euclid Avenue, Cleveland, are engineers.

ELYRIA, OHIO—Preparations are being made to build a power plant for the Elyria Memorial Hospital, to cost about $5,000, for which bids have been received. P. Rissman, Elyria Building, is architect.

LAKEWOOD, OHIO—Bids will be received by N. C. Cotabish, director of public works of the city of Lakewood, City Hall, until Dec. 18 for lighting the public streets, alleys and highways of the city for a period of ten and five years, beginning April 1, 191..

LORAIN, OHIO.—The Lorain County Electric Company has petitioned the Public Utilities Commission for authority to take over the property and franchises of the Citizens Gas & Electric Company of Lorain. Extensive improvements are contemplated by the Lorain company. Contracts have been awarded for additional equipment for the generating stations, including a 12,000-hp. turbo-generator, new boilers, etc. It is also proposed to rebuild the entire street-lighting system in Lorain. The cost of the proposed improvements is estimated at about $300,000.

MASSILLON, OHIO.—The Massillon Electric & Gas Company contemplates the installation of a new street-lighting system, bids for which will soon be asked for. The company estimates the cost of the maintenance of the proposed system at $25,000 per year against $14,738 per annum for the system now in use.

NEW VIENNA, OHIO.—Negotiations are under way between the Town Council and the Dayton (Ohio) Power & Light Company for the purchase of the municipal water and light plants in New Vienna. If the system is taken over the company will extend its transmission line from Dayton to New Vienna and establish a twenty-four-hour service, and also install new street lamps.

REPUBLIC, OHIO.—At an election to be held Dec. 19 the proposal to issue $10,000 in bonds for the installation of a municipal electric-light plant in Republic will be submitted to the voters.

TIFFIN, OHIO.—The Ohio Light & Power Company is planning to erect an electric transmission line from Tiffin to Shelby, a distance of 38 miles. Copper wire has already been purchased for the line.

TOLEDO, OHIO.—The City Council has awarded the contract for furnishing electricity to operate the high-pressure fire pumping station at Cherry and Water streets to the Toledo Railways & Light Company for a period of five years.

PADUCAH, KY.—The Paducah Light & Power Company has submitted a proposal to the City Commission offering a reduction in the rate and service charges. W. A. Gardner, commissioner of public property, who has charge of the municipal electric plant, has recommended that the municipal plant be equipped to provide electrical service for the entire city. He estimates that the plant can be equipped at a cost of less than $30,000, exclusive of the distributing system.

BERWYN, ILL.—Bids will be received by the City Council until Jan. 2, 1917, for the installation of an ornamental street-lighting system and also a street-lighting system for the city of Berwyn, to cost about $15,000. For details see proposal columns.

CASEY, ILL.—Bids will be received by H. C. Leggett, secretary of board of education, Casey, Ill., until Jan. 4, for construction of a township high school building, District No. 2. Separate bids to be submitted for heating and ventilating, plumbing and drainage work and for electric wiring. Louis H. Osterhage, Second National Bank Building, Vincennes, Ind., is architect.

CHICAGO, ILL.—Plans have been completed for the construction of a power house, to cost about $90,000, for Darling & Company, fertilizers. Bids for construction of plant, it is reported, will be asked at once. C. A. Alling, 4201 South Ashland Avenue, is president and general manager.

KINCAID, ILL.—The Central Illinois Public Service Company of Mattoon, it is reported, contemplates increasing the output of its system by 10,000 kw. New steam generating units, it is understood, will be added to the Harrisburg and Christopher plants. A 6000-hp. generating unit, it is stated, will be installed at the Kincaid plant. M. E. Sampsell of Chicago is president of the company.

OTTAWA, ILL.—The Chicago, Ottawa & Peoria Railway Company is rebuilding its electric transmission line connecting Spring Valley and the power plant of the Northern Illinois Light & Traction Company.

SHERRARD, ILL.—The Sherrard Power System Company, recently incorporated, proposes to construct and operate an electric light and power system in Sherrard. The company is capitalized at $30,000. D. W. Bowen, B. Bowen and Joseph Klucker are interested.

TUSCOLA, ILL.—The City Council has passed a resolution providing for the installation of an ornamental lighting system in the business district. The Central Illinois Public Service Company of Mattoon furnishes electrical service here.

BLACK EARTH, WIS.—The installation of an electric plant in Black Earth is under consideration. William Meister is reported interested.

MILWAUKEE, WIS.—The Line Material Company of South Milwaukee has been awarded the contract to supply 3700 lamps of two sizes for the municipal electric-lighting distribution system, at $21,860. F. A. Vaughan is engineer in charge of the city lighting system.

DES MOINES, IOWA.—Plans have been prepared by the City Council for the installation of an ornamental street-lighting system, consisting of over 1000 units, in the downtown district. It is expected to have the system installed by April 1, 1917.

GRINNELL, IOWA.—Bids will be received by W. G. Ray, secretary of board of education of the independent school district of Grinnell, until Dec. 28, for construction of grade school building. Separate bids to be submitted on construction work, heating and plumbing, and electric wiring. Reimer & Herlin of Marshalltown, Iowa, are architects.

KANSAS CITY, MO.—Th ordinance calling for replacing 1400 arc lamps with incandescent lamps has been signed by Mayor Edwards.

ST. LOUIS, MO.—Contract has been awarded by the Century Electric Company for the construction of a new building, to cost about $37,000, to be used in part for manufacturing electrical equipment and part for storehouse.

NAPOLEON, N. D.—Contracts, it is reported, have been awarded for the installation of an electric-light plant in Napoleon.

PORTLAND, N. D.—The City Council has authorized an issue of $2,000 in bonds for the installation of an electric-lighting system.

DELL RAPIDS, S. D.—Bonds to the amount of $40,000 have been voted for the installation of an electric-light plant. The plans provide for the purchase of the Van Eps water power and dam in Dell Rapids.

ODELL, NEB.—The local electric-light plant, owned by James Barry, was recently destroyed by fire.

OMAHA, NEB.—At an election held Dec. 5 the contract proposed by the Omaha Electric Light & Power Company for lighting the streets of the city for a period of five years was approved by the voters. The new contract provides for extensive improvements to the street-lighting system.

ASHERVILLE, KAN.—Negotiations are under way between local business men and the Concordia (Kan.) Electric Light Company whereby the electric transmission line may be extended from Simpson to Asherville to supply electrical service here.

CULVER, KAN.—The City Council has granted Fay W. Austin a franchise to install an electric-light plant and also has contracted for 10 street lamps of 150 cp. Mr. Austin proposes to install one 25-kw. and one 16-kw. generator in the basement of Black's Real Estate Building.

McCRACKEN, KAN.—The City Council, it is reported, is contemplating securing electrical energy for commercial purposes from some adjoining town.

Southern States

CHARLOTTE, N. C.—Surveys have been made by the Piedmont & Northern Railway Company of Charlotte for an extension from Gastonia to Kings Mountain.

CHARLESTON, S. C.—The Charles & Summerville Interurban Railway Company is reported to be contemplating the construction of an electric railway from Charleston to Summerville, a distance of 22 miles.

McGEHEE, ARK.—The City Council has authorized the installation of an electric generator and switchboard in the municipal electric-light plant, to cost about $4,000.

DUNCAN, OKLA.—Bids, it is reported, will be received by the town of Duncan until Dec. 18, for an electric generator and electrical equipment for street-lighting system. E. W. Mitchell is clerk.

MOUNDS, OKLA.—The installation of a municipal electric-light plant in Mounds is under consideration.

OKLAHOMA CITY, OKLA.—An issue of $1,000,000 in bonds is reported under consideration by the Southwestern Power, Light & Railway Company, 406 Security Building, Oklahoma City, for the construction of hydroelectric plants on the Washita River, beginning at Lindsay, Okla., on down to Crusher Station (about five plants). Energy generated at these plants will be transmitted to Ardmore, Oklahoma City, Shawnee and other cities. The plans provide for an ultimate development of about 75,000 hp. W. T. Croslen of Oklahoma City is consulting engineer.

AUSTIN, TEX.—A bond issue of $230,000 has been authorized for the construction of municipal docks and terminals and the installation of electric loading and unloading devices upon the water front; an issue of $100,000 bonds is now available for enlarging the municipal waterworks system.

FLOYDADA, TEX.—The installation of new equipment in the municipal electric plant is under consideration.

GALVESTON, TEX.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 4, for remodeling electric passenger elevator in the United States post office and custom house in Galveston. For details see proposal columns.

GUSTINE, TEX.—Plans are being considered by W. T. Ball of Comanche for the installation of an electric-light plant in Gustine.

HIGGINS, TEX.—Bonds have been authorized for the installation of an electric-lighting and water-works systems.

MARLIN, TEX.—Plans are being considered by the City Council for the installation of an electric generator in connection with the waterworks pumping station.

WELLINGTON, TEX.—The plant of the Wellington Power & Light Company has been purchased by B. F. Godwin. Improvements will be made to the system.

Pacific States

ABERDEEN, WASH.—The fire and light committee of the City Council is endeavoring to secure better lighting facilities for the outlying residence districts, especially for the West End section.

INDEX, WASH.—The Town Council, it is reported, is considering the installation of a municipal electric-light plant. At present electrical service is furnished by the Index-Galena Company.

LA GRANDE, WASH.—The American Nitrogen Products Company, Securities Building, Seattle, has closed a contract with the Tacoma municipal electric system for energy to operate the first unit of its plant, which it is erecting at La Grande, at a cost of about $500,000. The company filed water rights on a site on the Suak-Suiattle River, 50 miles north of Everett, several years ago, and intended to build its plant there, but pending the decision of the Seattle municipal lighting department as to the advisabilty of the site for municipal power purposes, decided not to wait until the city of Seattle had waived its claim to the power site.

RITZVILLE, WASH.—The Pacific Power & Light Company of Portland, Ore., has petitioned the County Commissioners for a franchise to erect and maintain electric transmission lines along various county roads.

SEATTLE, WASH.—The Kilbourne & Clark Manufacturing Company of Seattle has secured a contract from Hannevig Brothers of Norway and New York for equipping 170 steamships of its fleet with wireless equipment. The contract amounts to about $400,000 and provides that all additional ships to be built by the company during the next three years shall be equipped with these wireless systems. F. C. Simpson is manager.

SPOKANE, WASH.—Petitions have been presented to the City Council for extension to the new street-lighting system on Washington Street, from Trent Avenue to Fourth Avenue. Petitions are also in circulation asking for improvements to the lighting system on Post, Howard and Lincoln Streets.

KLAMATH FALLS, ORE.—The Keno (Ore.) Power Company has applied to the Council for a franchise to supply electricity in Klamath Falls in competition with the California-Oregon Power Company.

PORTLAND, ORE.—The city of Portland will soon ask for bids for street-lighting for a period of from one to five years. The present contract with the Portland Railway, Light & Power Company will expire Dec. 31.

CARPENTERIA, CAL.—The Council is considering calling a special election to submit the proposal to issue bonds for the installation of an electric-lighting system to the voters.

DUNNIGAN, CAL.—The State Railroad Commission has authorized the Northern California Power Company of San Francisco to extend its electric transmission line from College City to Dunnigan in Yolo County, and to furnish electricity to all of Yolo County not now served by the Pacific Gas & Electric Company.

HANFORD, CAL.—Bids will be received by the Board of Supervisors until Jan. 2, 1917, for the purchase of a 50-year franchise to erect and operate electric transmission lines over the roads and highways of Kings County. E. F. Pickerell is clerk of board.

HORNBROOK, CAL.—The Northern California Power Company, 995 Market Street, San Francisco, is now building a dam across the Klamath River, near Hornbrook. The equipment of the power plant will include two generators of 12,500 kw. each.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company has applied for a franchise to extend its electric transmission lines to San Juan Capistrano.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company has petitioned the State Railroad Commission for authority to issue $312,000 in bonds and $14,600 in capital stock, the proceeds to take up outstanding indebtedness and to pay for construction expenditures between Nov. 1 and Dec. 21, 1916. Expenditures for the gas department are estimated at $60,000 and for the electric department $60,000. The latter includes $28,000 for the overhead system from Del Mar to Oceanside and part of the line to San Juan Capistrano; the cost of the pole line and fixtures to San Luis Rey-Fall Brook transmission line is estimated at $24,000, and improvements to the municipal street-lighting system in San Diego and Oceanside at $6,500.

SAN FRANCISCO, CAL.—Plans are being considered by the Mission Promotion Association for a new lighting system on Sixteenth Street, between Howard and Dolores streets.

SAN FRANCISCO, CAL.—The Northern California Power Company has petitioned the State Railroad Commission for permission to make use of a franchise granted by Yolo County to extend its transmission line from College City to Dunnigan.

TERRA BELLA, CAL.—The contract for construction of electric transmission lines, transformer stations, etc., for the Terra Bella irrigation district has been awarded to the City Electric Supply Company of Riverside.

TURLOCK, CAL.—The Tidewater Southern Railroad Company is reported to be considering an issue of $600,000 in capital stock, the proceeds to be used to equip its railroad from Modesto to Turlock for electrical operation and also an extension to Twin City. J. H. Wallace of Stockton is chief engineer.

BOISE, IDAHO.—The State Utilities Commission has granted E. Goodman permission to erect an electric plant on the Fayette River.

BINGHAM, UTAH.—The City Council has entered into a contract with the Utah Power & Light Company of Salt Lake City for lighting the streets of the city. The contract calls for twenty-five lamps of 1000 cp. and forty lamps of 400 cp.

HUNTSVILLE, UTAH—Articles of incorporation have been filed by the Petersen family of Huntsville with the county clerk for the purpose of supplying electricity for lamps and motors in Huntsville and adjoinng territory.

DOUGLAS, ARIZ.—Bids will be received by the city clerk of Douglas until Dec. 27 for complete installation of ornamental lighting system, consisting of approximately 107 cast-iron single-lamp standards mounted with lamps of 400 cp., 23,000 ft. No. 6 solid lead covered, rubber insulated cable, 8000 ft. 2-in. conduit, necessary foundations, etc. Plans and specifications are on file with the city clerk. George N. Wood is city engineer.

BUTTE, MONT.—The Great Northern Railway Company, it is reported, contemplates turning over its water power sites in the State of Washington, particularly that at Lake Chelan, to the Montana Power Company of Butte for development in connection with its plans for equipping its railroad for electrical operation. The Montana Power Company furnishes energy for operating the 400 miles of the Chicago, Milwaukee & St. Paul Railway Company's electric road through Montana. The cost of developing the Lake Chelan site is estimated at $2,000,000.

LIBBY, MONT.—An auxiliary power plant of 125 hp., operated by a crude oil engine, will be installed by the Libby Water Works, Electric Light & Power Company, at a cost of about $10,000. The new unit will be operated entirely separate from the present hydroelectric plant.

WHITE SULPHUR SPRINGS, MONT.—The transfer of the electric franchise to M. Hoover of Saco, who proposes to take over the local plant and make extensions and improvements to the system, has been approved by the City Council.

MEETEETSE, WYO.—The installation of an electric-lighting system in Meeteetse is under consideration. G. A. Reding is reported interested.

Canada

VANCOUVER, B. C.—The Legislature will soon be asked to sanction an amendment to the city charter giving the city of Vancouver the right to own and operate an electric-light and power plant and distributing system in opposition to the British Co-

lumbia Electric Railway Company or any other public service corporation.

OIL SPRINGS, ONT.—Plans are being considered by the Council for the installation of a hydroelectric lighting and power distribution system, to cost about $15,000.

STRATHROY, ONT.—Extensions to the street-lighting system are reported to have been authorized by the Town Council.

TORONTO, ONT.—The erection of several street lamps and also an improved lighting system for part of University Avenue has been recommended by the works committee.

TORONTO, ONT.—The Provincial Hydro-Electric Commission, it is stated, will proceed with actual construction on the Chippewa Canal project in the spring; the work will be done by the commission. An expenditure of about $800,000 will be necessary for the purchase of motors, excavating machinery, railway tracks, etc., to dig a 12-mile canal through which the water will be taken from Chippewa Creek to Queenston, the outlet below the falls where the hydroelectric plant will be built. The cost of excavating the canal is estimated at between $8,000,000 and 9,000,000. Sir Adam Beck is chairman of commission.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, Washington, D. C., until Jan. 2, 1917, for furnishing crane chain, water gages, lamps, grease cups, electric hair drier, daubers, ignition cable, etc. Blanks and general information relating to this circular (No. 1107) may be obtained from the above office or the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

Record of Electrical Patents

Notes on United States Patents issued on Dec. 2, 1916.

1,206,845. FIRE-ALARM SYSTEM; George W. Hochsprung, Brooklyn, N. Y. App. filed Nov. 23, 1914. For giving notice of a fire and locating the place whence an alarm is sent in.

1,206,846. INSULATOR; Roy S. Hopkins, Fairmount, W. Va. App. filed Jan. 14, 1916. For use on telephone and telegraph lines.

1,206,850. VENTILATION SYSTEM FOR STORAGE-BATTERY CELLS; Albert S. Hubbard, New York, N. Y.; App. filed Dec. 3, 1914. Particularly when the cells are sealed.

1,206,881. METHOD OF MAKING DIAPHRAGMS; Henry C. Miller, Waterford, N. Y. App. filed June 2, 1913. Any number of diaphragms can be made exactly alike to receive and reproduce the same sound qualities.

1,206,882. INSULATING-TUBE; Carl T. Morene, Nixon, Tex. App. filed Aug. 21, 1916. New and useful improvements.

1,206,885. METHOD OF ELECTRICAL EDGE-WELDING; Thomas E. Murray, New York, N. Y. App. filed March 2, 1916. Of a structure formed of metal sheets or plates.

1,206,890. METHOD OF ELECTRIC SPOT-WELDING; Thomas E. Murray and Le Roy H. Hoffer, of New York, N. Y. App. filed June 28, 1916. Proportioning the electrodes, between which the plates are disposed.

1,206,907. CARBON-BRUSH HOLDER; John B. Peters, Toledo, Ohio. App. filed Jan. 20, 1913. New and useful Improvements.

1,206,911. SYSTEM OF RADIO COMMUNICATION; Greenleaf Whittier Pickard, of Amesburg, Mass. App. filed Oct. 28, 1914. Comprising a more efficient transmitter.

1,206,955. RAILWAY-SIGNALLING; Herbert A. Wallace, New York, N. Y. App. filed March 4, 1912. For single track over which traffic moves in both directions.

1,206,963. ELECTROLYTIC APPARATUS; Robert L. Whitehead, Perth Amboy, N. J. App. filed Feb. 10, 1913. Connections for maintaining electric contact.

1,206,965. ELECTROLYTIC APPARATUS; Robert L. Whitehead, Perth Amboy, N. J. App. filed Feb. 10, 1913. Connections and arrangement of the electrodes.

1,206,987. DICTATING PHONOGRAPH SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed Nov. 14, 1914. An arrangement of circuits and apparatus therefor, including telephone transmitters and speech recording phonographs.

1,206,988. ELECTRICAL ALARM; John G. Clemens, Buffalo, N. Y. App. filed June 3, 1913. Used in connection with alternating electric currents.

1,207,016. CIRCUIT-BREAKING RELAY; Roy C. Fryer, Detroit, Mich. App. filed June 7, 1915 Provides a non-vibrating relay that is positive in its action.

1,207,048. METHOD OF ELECTROLYTICALLY RECOVERING METALS; William A. Hussey, Oakland, Cal. App. filed June 26, 1912. New and useful Improvements.

1,207,051. TELEPHONE REPEATERS OR RELAY; Arcy H. Johnson, Pulaski, Tenn. App. filed Feb. 12, 1916. Employ conductors or ordinary galvanized iron wire in place of the copper lines now employed.

1,207,090. MEANS FOR VENTILATING TELEPHONE BOOTHS; Eben J. Stevenson, Boston, Mass. App. filed June 14, 1915. Electric fan.

1,207,097. SNAP-SWITCH FOR ELECTRIC USES; William C. Tregoning, Cleveland, Ohio. App. filed Oct. 26, 1914. Spring pressed actuating member.

1,207 099. INDICATOR; Thomas W. Varley, New York, N. Y. App. filed April 28, 1913. Applicable in connection with railway signaling.

1,207,126. SPEED-INDICATING DEVICE FOR MOTOR-VEHICLES; Ary A. Benson, Seattle, Wash. App. filed Feb. 23, 1916. For recording the rate of speed at which a motor vehicle was traveling at the time of a collision.

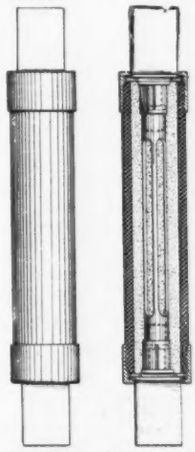
1,207,127. METHOD OF AND APPARATUS FOR OBTAINING ZINC; Edward S. Berglund, Trollhattan, Sweden. App. filed Sept. 15, 1914. To reduce the carbon dioxide and other oxidizing gases mixed with the exhausting zinc gases.

1,207,150. AUTOMATIC TELEPHONE SWITCHING SYSTEM; Alfred H. Dyson, Montclair, N. J. App. filed March 8, 1915. Controlling circuits for switching apparatus.

1,207,156. LAMP-SOCKET FIXTURE; Edgar H. Freeman, Trenton, N. J. App. filed June 29, 1915. Means for securing the socket to the end of a supporting fixture.

1,207,157. STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES; Ernest Fuchs, Billancourt, France. App. filed Feb. 1, 1915. By means of an auxiliary electric motor.

1,287,163. TIME-CONTROLLED DEVICE; William H. Greenleaf, Hartford, Conn. App. filed Nov. 18, 1915. Embodied in a secondary clock.



No. 1,207,351—Electric Fuse

1,207,168. AUTOMATIC SWITCH; Alfred W. Houchin, Greensboro, Md. App. filed June 7, 1912. For automatically closing the line circuit across the armature of a dynamo.

1,207,169. SPARKING DEVICE FOR HYDROCARBON-ENGINES; Harry Hovgard, Brookline, Mass. App. filed Sept. 3, 1914. Spark plug combined with an induction coil.

1,207,191. BASE-BALL SIGNALING AND INDICATING SYSTEM; Samuel L. Madden, Chattanooga, Tenn. App. filed Feb. 16, 1916. For use in baseball parks.

1,207,193. IGNITION SYSTEM; Charles Thomas Mason, Sumter, S. C. App. filed April 7, 1915 In which the magneto windings are energized by the operation of the magneto or an auxiliary source of current or both.

1,207,194. INDICATOR FOR AUTOMOBILES; Clarence M. Michener and Arthur C. Baumann, of New York, N. Y. App. filed June 25, 1915. To show in which direction the automobile is about to turn.

1,107,197. ARMATURE-WINDING; Theodor M. Mueller, Detroit, Mich. App. filed Sept. 8, 1913. An improved form of winding.

1,207,260. ELECTRICAL SWITCH; Herbert A. Yearick, Sunbury, Pa. App. filed Feb. 2. 1916. Operating means for the blade or blades to be readily applied to or removed from operative assemblage.

1,207,261. PROCESS OF RECOVERING GOLD. James H. Alling, Columbia, Cal. App. filed Oct. 18, 1910. New and useful improvements.

1,207,283. CLEANING, PLATING, DRYING AND BURNISHING MACHINE; Winford L. Enghauser, Winslow Park, Ohio. App. filed March 1, 1916. Single machine for use in all of the operations.

1,207,287. STORAGE BATTERY; Bruce Ford, Philadelphia, Pa. App. filed May 19, 1915. Adapted for use upon boats or ships.

1,207,293. STORAGE BATTERY; Carroll Hoogem. Radnor, Pa. App. filed May 29, 1915. To prevent breakage.

1,207,295. MEANS FOR CONTROLLING ELECTRICALLY-PROPELLED VEHICLES; Oscar Johnson, Chicago, Ill. App. filed Jan. 27, 1913. For making emergency stops.

1,207,321. INSULATOR-SUPPORT; Charles L. Peirce, Jr., Pittsburgh, Pa. App. filed Oct. 15, 1915. For high-tension transmission line service.

1,207,325. SWITCH-LOCK; Ernest K. Post, Altoona, Pa. App. filed April 16, 1915. To protect railway switches accidental displacement.

1,207,347. METHOD OF OBTAINING ULTRA-VIOLET RAYS BY SPARK DISCHARGE; Joseph von Kowalski-Wierusz, of Fribourg, Switzerland. App. filed April 10, 1914. New and useful improvements.

1,207,351. ELECTRIC FUSE; Frederick N. Wake, New York, N. Y. App. filed March 22, 1915. Renewable fuses.

1,207,359. COMMUTATOR; Michael Auffero, Brooklyn, N. Y. App. filed April 5, 1915. For use with very small electric motors.

1,207,381. METHOD OF DEHYDRATING AND REFINING HYDROCARBON-OILS; Ernest I. Dyer, Oakland, Cal. App. filed March 5, 1913. To increase the yield of the lighter distillates over that obtained by the methods at present resorted to for dehydrating and refining the hydrocarbon oils without danger of breaking down the lighter fractions.

1,207,382. PRIMARY BATTERY; Thomas A. Edison, Llewellyn Park, West Orange, N. J. App. filed May 24, 1910. Improve the construction of batteries both mechanically and electrically.

1,207,384. ELECTRIC AMPLIFIER; Henry C. Edgerton, Passaic, N. J. App. filed Aug. 15, 1914. Provide an improved magnet system.

1,207,388. METHOD AND APPARATUS FOR SUBMARINE SIGNALING; Reginald A. Fessenden, Brookline, Mass. App. filed Jan. 29, 1913. New and useful improvements.

1,207,395. BRAKE-LOCK FOR AUTOMOBILES. Leon Goldmerstein, New York, N. Y. App. filed Dec. 8, 1915. Electro-magnetically controlled.

1,207,419. RECEIVER; Oscar M. Leich and Alexander C. Reid, Genoa, Ill. App. filed Jan. 27, 1916. Extreme lightness.

1,207,459. CATENARY HANGER; Henry B. Wolfe, Mansfield, Ohio. App. filed Nov. 10, 1915. For trolley wires.

1,207,463. DISCONNECTING DEVICE FOR TELEPHONES; Charles H. Alger, Manchester, Okla. App. filed Feb. 2, 1913. Protect against lighting.

1,207,483. CATENARY HANGER; Glenn Henry Bolus, Mansfield, Ohio. App. filed Nov. 10, 1915. For trolley wires.

1,207,484. CATENARY HANGER; Glenn Henry Bolus. Mansfield, Ohio. App. filed Nov. 10, 1915. New and useful improvements.

1,207,521. STORAGE-BATTERY COMPOUND; Nathan Fallek, Denver, Col. App. filed March 23, 1914. Consists of asbestos and sulfuric acid to which may be added a small proportion of sodium silicate.

1,207,565. INDICARING SYSTEM; Adolph ern, Jersey City, N. J. App. filed March 21, 1916. For cars passing each other upon parallel tracks.

1,207,603. ELECTRIC SWITCH; Harry J. Morey and Fay A. Brogden, Syracuse, N. Y. App. filed April 21, 1913. Used in lamp sockets.

1,207,613. FASTENING; Charles Ohaven Galesburg, Ill. App. filed April 23, 1915. For use in connecting cross arms to telegraph poles.

1,207,614. ELECTRICAL-TREATMENT APPARATUS; Wilson A. Olds, Medical Lake, Wash. App. filed Aug. 17, 1914. Energized portions pass across the nerve centers and the trunk nerves.

1,207,623. PORTABLE ELECTRIC LAMP; Adolph C. Recker, Oakville, Conn. App. filed April 10, 1916. Flashlight lamp.

1,207,653. CATENARY HANGER; William C. Starkey, Mansfield, Ohio. App. filed Sept. 22, 1915. To wires or cables that are suspended in substantially horizontal position.

1,207,660. AUTOMATIC SAFETY-STOP FOR LINE-SHAFTS; Caswell D. Sweet, Redwood City, Cal. App. filed June 6, 1914. To overcome momentum of line-shafts.

1,207,694. METHOD OF PRODUCING GRANDULAR CARBON FROM GAS REFUSE; Robert D. Pike, San Francisco, Cal. App. filed April 1, 1916. New and useful improvements.

Recent Radio Patents

Notes and Comments on United States Patents on Radio Signaling and allied topics issued during November, 1916.

1,204,720. CIRCUIT ARRANGEMENT FOR WIRELESS TRANSMITTERS; Egbert von Lepel. Berlin-Wilmersdorf, Germany. App. filed Feb. 11, 1914; issued Nov. 14, 1916. A tone-circuit for direct-current arc or spark transmitters, in which the radio frequency condenser is subdivided. Across one section of the serially divided condenser is connected a large inductance, of such value that the frequency of the local circuit thus formed correspond to a musical tone. The effect is to radiate tonally modified groups of sustained waves without use of a chopper or interrupting device.

1,204,748. WAVE-METER; Burr V. Dietz, Slingerlands, N. Y. App. filed Nov. 19, 1914; issued Nov. 14, 1916. An automatic wavemeter in which a condenser is associated with three inductance coils. The coils have subdivisions corresponding to units, tens and hundreds of meters of wavelength; the resonance voltage set up operates an indicating mechanism from which the wavelength may be read directly.

1,205,365. METHOD AND APPARATUS FOR WIRELESS TELEPHONY; John P. McCarty, Oakland, Cal., and Kendall Douglas, San Francisco, Cal. App. filed March 6, 1912; renewed Sept. 30, 1916; issued Nov. 21, 1916. Wireless telephone transmitter in which a microphone shunts the oscillation transformer secondary from antenna to ground. When talking is not being done, little or no wave energy is radiated; when speech begins, waves are radiated with their rate of emission, energy and form directly corresponding to the pitch, force and quality of the sounds.

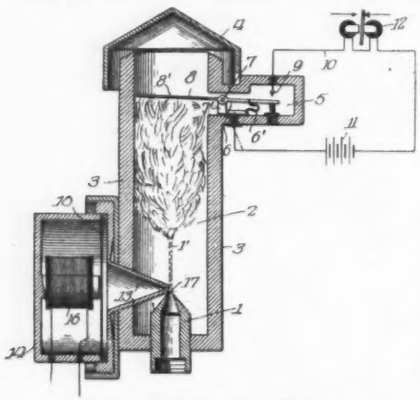


Fig. 1—Hall's Set Relay

1,205,469. APPARATUS FOR SPACE TRANSMISSION OF ENERGY; Frederick H. Millener, Omaha, Neb. App. filed April 10, 1911; issued Nov. 21, 1916. A wireless telephone outfit of the arc type, in which modulation of emitted waves is secured by the use of a plurality of microphones associated with transformers whose secondaries are in parallel and form part of the closed oscillation circuit. The arc proper has one rotating electrode dipping into an electrolyte which is dissociated electrolytically to provide a hydrogen atmosphere.

1,205,530. METHOD OF AND MEANS FOR TRANSLATING SOUNDS; Ray E. Hall, Portland, Ore. App. filed April 16, 1914, renewed April 20, 1916; issued Nov. 21, 1916. A relay for recording wireless signals, in which the sound impulses from a telephone receiver are applied to the base of a liquid or gaseous jet and result in a diametric spreading of the jet's end. This spreading operates a contact by moving a perforated vane which is not ordinarily affected by the jet, and so energizes a relay, recorder or sounder.

1,206,352. APPARATUS FOR WIRELESS TRANSMISSION OF ENERGY; Frederick H. Millener, Omaha, Neb. App. filed April 29, 1911; issued Nov. 28, 1916. A group of series oscillation arcs for radio telephony. The positive electrodes are copper, of hemispherical shape, and water-cooled. The arc burns in air on the internal hemispherical surface. It is contended by the patentee that this construction prevents hissing of the arc and consequently improves the quality of speech transmission. Modulation is secured by use of the microphone and transformer combination claimed in patent No. 1,205,429, described above.

1,206,353. ANTENNA AND SUPPORT THEREFOR FOR USE IN WIRELESS TELEGRAPH OR TELEPHONE SYSTEMS; Frederick H. Millener, Omaha, Neb. App. filed Jan. 19, 1912; issued Nov. 28, 1916. Umbrella-like aerial structure in which a number of harp sections are guyed out along conical elements from a single tower. Each harp is built by stringing a single wire back and forth between two stretchers, leaving the wire free to slide for the purpose of preventing severe stresses from sleet and the like. Shows means of using railway sections as a counterpoise ground of variable capacity.

1,206,643. CONTROLLING ALTERNATING CURRENTS; Ernest F. W. Alexanderson, Schenectady, N. Y. App. filed Dec. 7, 1912; issued Nov. 28, 1916. A magnetic amplifier, particularly for use in radio signaling, in which the applied radio frequency current is varied in amount according to the modulations of a smaller current acting to change the magnetization of a pair of impedance coils. The secondaries of these double-wound impedances are opposed with respect to the radio frequency source, so that no radio frequency current is induced in the control circuit.

DISCUSSION

Only eight patents of particular interest to radio engineers were issued by the U. S. Patent Office during the month of November, in contrast to fourteen for October and twelve for September. In the twenty-two weeks since July 4 (the first issue date in that month), there have been issued fifty-four patents on radio signalling and allied topics, and all of these have been digested in the ELECTRICAL WORLD'S engineering issues which appear on the third Saturday of each month.

Among the November patents, reviewed above, two are of particular interest. Both are, in a general sense, directed toward amplifying operations; but one is used at the receiving station and the other at the sender. The Hall relay is used to record incoming messages, while the Alexanderson magnetic amplifier is utilized for impressing signal sounds upon a radio frequency current at the transmitter.

Fig. 1 is reproduced from the specification of patent No. 1,205,530, of Ray E. Hall, and shows the details of the mechanism which he proposes to use for producing a permanent record of incoming wireless messages. The device is purely a relay, and the figure shows none of the usual radio receiving apparatus with the exception of the telephone receiver 14, which comprises the diaphragm 15 and magnet 16. This receiver, as shown, is mounted upon the side of a cylindrical chamber 3 along the axis of which there flows a fluid jet 1', of either gaseous or liquid form, which is supplied under pressure from the orifice 17 in the jet-nozzle 1. A concentrating sound passage or funnel 13 connects the diaphragm chamber of the telephone with the jet container, and has its small opening very close to the base of the jet itself.

At the end of the chamber 3 distant from the nozzle 1 there is supported a pivoted vane 8 having a circular perforation 2' in its center. This is free to move about the axis 7; its outer end is arranged to contact with the point 9 whenever the spring 6' is allowed to act, and thus the circuit including the wire 10, relay 12 and battery 11 may be closed.

In ordinary operation, when no signals are being received the jet takes the form of a solid stream and passes through the hole 8' in the vane 8. Thus the spring is enabled to close the circuit by bringing the two contacts together. When signals are picked up by the wireless receiver, however, sound waves are given off by the telephone and projected against the base of the jet as indicated. These compressions and rarefactions usually tend to break up the jet, and give it the expanded form shown in the figure. Its velocity therefore causes it to move the vane against the spring and to open the circuit. Thus for each dot and dash reproduced as sound waves by the telephone 14, the circuit 10 is opened for a corresponding short or long period of time. Obviously the actions of the circuit may be inverted through a back contact relay and used to control a Morse recorder of the ordinary type. Under some conditions, the patentee points out, the jet may act oppositely; that is, when signals are received the stream may take the confined form and permit the circuit to close, the normal condition being as shown in Fig. 1 with the circuit held open. In such instances a front-contact relay is used, or the contact current itself applied to the recorder or register.

E. F. W. Alexanderson's patent No. 1,206,643 contains as a part of its drawings the diagram which is reproduced as Fig. 2. Here a radio frequency alternator 6 is connected to the primary 15 of an oscillation transformer, through a suitable condenser and the windings 8 and 9 of two reactance coils. A second condenser is shunted across the said primary, and an antenna circuit 17 is inductively coupled as shown.

Additional windings 10 and 11 are placed upon the two reactances, and are connected serially with a telephone transmitter 16 and a battery 12. It will be noted that the coils 10 and 11 are serially connected in the opposite sense, with respect to the radio frequency current, from coils 8 and 9. The result of this is that the radio frequency electromotive forces generated in the two transformer-reactances are opposed and neutralize each other's effects in the microphone circuit.

The power applied to the aerial system by the main lines, as at 14, is of course determined by the value of the impedance coils 8 and 9. By suitably proportioning the various parts and by choosing a proper value for the battery current through the control windings 10 and 11, the magnetization of the cores in the reactances may be largely altered in a manner depending solely upon the current variations in the microphone circuit. These chages in magnetization or magnetic density produce corresponding changes in the reluctance of the reactances' magnetic circuits, and therefore in the impedance of the coils themselves. Thus the voltage applied to the sending condenser at 14 may be varied by and in accordance with the vocal vibrations applied to the microphone 16.

Numerous minor alterations of the plan may be resorted to in applying it to various special conditions. For small powered wireless telephone transmitters the exact arrangement shown in Fig. 2 may be utilized; where it is desired to control greater amounts of radio frequency power the speech-current from the microphone may be amplified by a vacuum-relay system before it reaches the windings 10, 11. For sustained wave radiotelegraphy a musical tone may be impressed upon the radiated waves by substituting an alternating-current generator of say 500 or 1000 cycles in place of the microphone and battery. There is no reason requiring physical separation of the two reactance coils, and for mechanical convenience and economy it is often desirable to build both as a single structure having a divided magnetic path. Some interesting experiments with an amplifier of this general type, in which about 75 kw. of radio frequency power at 50,000 cycles was modulated by speech waves, were described in the April, 1916, issue of the Proceedings of the Institute of Radio Engineers.

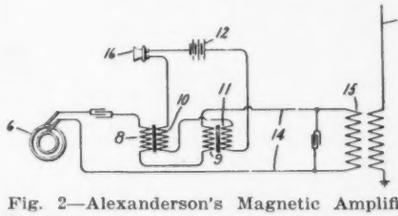


Fig. 2—Alexanderson's Magnetic Amplifier

Dec. 10, 1916.